Vol. XXXVI March, 1953 No. 10

THE PHILIPPINE AGRICULTURIST

UNIVERSITY OF THE PHILIPPINES PUBLICATIONS SERIES A

CONTENTS

Livestock Breeding Procedures and Their Application at the UP College of Agriculture . . . . . *Valente Villegas* 447

Effect of Time of Applying Ammonium Sulfate on Growth and Yield of Rice . . . . . *J. R. Velasco, B. A. Narit, and D. B. Fernandez* . . 454

Control of Weeds and Destruction of Diseased Abacá Plants with Herbicides . . . . . *Alfredo L. Eloja* 474

Marketing Coconuts and Copra in the Upland Towns of Cavite . . . *Nathaniel B. Tablante and Marcos M. Nuestro* . . . 492

The Influence of Sulfamethazine on Mortality of Chicks Raised on Built-up Litter . . . . . *Ludovico N. Tayag* 503

A Trial Preparation of Bilbao Style Sausage . . . . . *Faustino Mensalvas and Faro B. Benitez* 511

College and Alumni Notes 518

Published by

THE COLLEGE OF AGRICULTURE
AND CENTRAL EXPERIMENT STATION
UNIVERSITY OF THE PHILIPPINES

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14 JUL 1954

The Philippine Agriculturist

(University of the Philippines Publications Series A)

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THE PHILIPPINE AGRICULTURIST is published monthly, except in April and May, beginning with Volume 35, by the College of Agriculture and Central Experiment Station, University of the Philippines, Los Baños, Laguna. The subscription price is ₱6.00 a year in the Philippines and $4.00 (U.S. currency) elsewhere; the price of single copies, ₱0.75 in the Philippines and $0.50 (U.S. currency) elsewhere.

Business correspondence should be addressed to the Business Manager, THE PHILIPPINE AGRICULTURIST, College, Laguna, Philippines. All remittances should be made payable to THE PHILIPPINE AGRICULTURIST.

Communications for the editor should be addressed to the Editor, THE PHILIPPINE AGRICULTURIST, College, Laguna, Philippines.

Publications sent in exchange for THE PHILIPPINE AGRICULTURIST should be addressed: Library, College of Agriculture and Central Experiment Station, College, Laguna, Philippines.

Entered at the Post Office at College, Laguna, Philippines, as second-class mail matter.

LIVESTOCK BREEDING PROCEDURES AND THEIR APPLICATION AT THE U. P. COLLEGE OF AGRICULTURE [1]

VALENTE VILLEGAS

WITH FIVE TEXT FIGURES

The system of breeding that a livestock raiser practices influences to a large extent the size, appearance, and performance of an animal. Promiscuous breeding among animals is harmful and leads to mediocrity, or worse, if not accompanied by selection.

Breeding of animals of close relationship within the same breed is spoken of as *inbreeding;* mating of diverse breeds is referred to as *outbreeding.* The degree of relationship between the individuals mated within the same breed distinguishes *closebreeding* from *linebreeding. Closebreeding* is the mating between parent and offspring or between full brother and sister. *Linebreeding* is the mating between half brother and sister or between cousins. In either system, satisfactory results are possible if the work is done intelligently by one having a comprehensive knowledge of the good and bad points of the animals being bred.

Inbreeding often leads to loss of vigor and fertility in the inbred animals. As a remedy, *outcrossing* is resorted to. In this system, animals of the same breed, usually males, that are not related by four or five generations to the females with which they are to be mated are introduced in the herd. Such males should excel not only in vigor and fertility but also in other desirable characters.

Inbreeding does not create either good or bad characters but merely purifies them. It therefore promotes uniformity among inbred animals. The closer the animal is to the ideal, the better the results will be. Rigid selection should be exercised. Sentimental partiality for any animal has no place in inbreeding work. Mediocrity or the presence of a bad fault is sufficient to disqualify an animal. Hidden (recessive) defects in an animal are made manifest by inbreeding. The results from inbreeding are more rapidly obtained with a large number of animals than with a few, and the opportunity to cull undesirable individuals is greater.

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[1] General Contribution No. 863. The writer is indebted to Dr. H. K. Hayes, visiting professor of plant breeding, Cornell-Los Baños Project, and Dr. J. M. Capinpin, associate professor and acting head, Department of Agricultural Botany, for valuable criticism of the paper.

[THE PHILIPPINE AGRICULTURIST, Vol. 36, No. 9, February, 1953, appeared in April, 1954]
THE PHILIPPINE AGRICULTURIST, VOL. 36, NO. 10, MARCH, 1953.

The Los Baños Cantonese chicken of the College of Agriculture is the result of inbreeding (fig. 1). The original stock gave only 29.8 eggs a hen in 1917-1918. Six years later, egg production was increased to 109.7 eggs a hen, and in 1932-1933, the production was from 132.6 to 139 eggs a hen. The champion hen, Miss Aggie, gave 237 eggs in 1928-1929.[2]

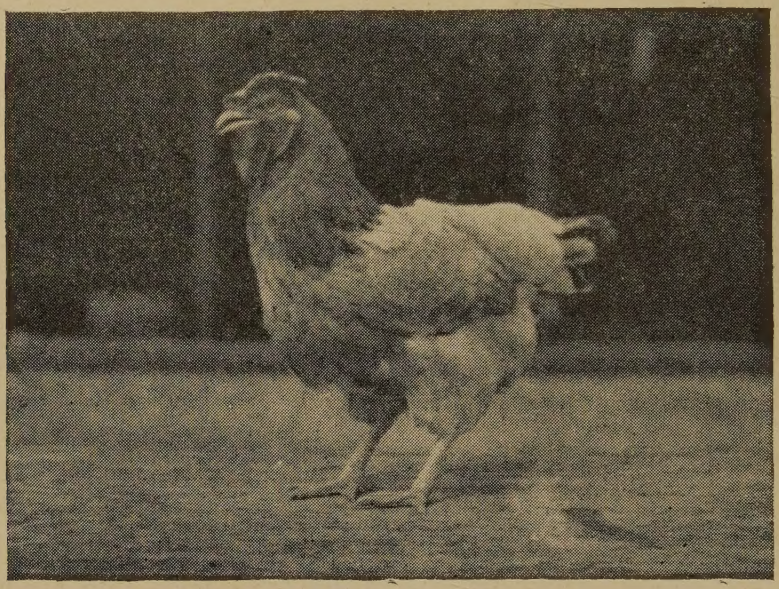

Fig. 1.—The Los Baños Cantonese hen developed through selection and inbreeding with emphasis on capacity for producing eggs.

Pedigree breeding is the mating of individuals whose ancestral histories are known. In this system the progeny test is used and the ability of the parents to produce desirable offspring is emphasized. Among dairy cattle, the bull capable of producing high milk-yielding progeny is selected for breeding.

Crossbreeding is the mating of animals of different breeds. The crossing of animals of different species, such as the horse and the ass or the Indian ox and the common ox, may be called *hybrid breeding* or *intergeneric* or *interspecific hybridization. Triple crossing* refers to crossbreeding of three breeds, as when a Berkshire pig is crossed with a Poland-China pig to produce a crossbreed that is afterwards mated with a Duroc-Jersey. It may be referred to as a *three-way cross* (fig. 2). In *crisscrossing,* two breeds are mated, the progeny is backcrossed with one of the parental breeds, and the resulting offspring is afterwards bred to the other parental breed (fig.3).

[2] Miguel Manresa, *Philippine Agriculturist,* 23, 433 (1934).

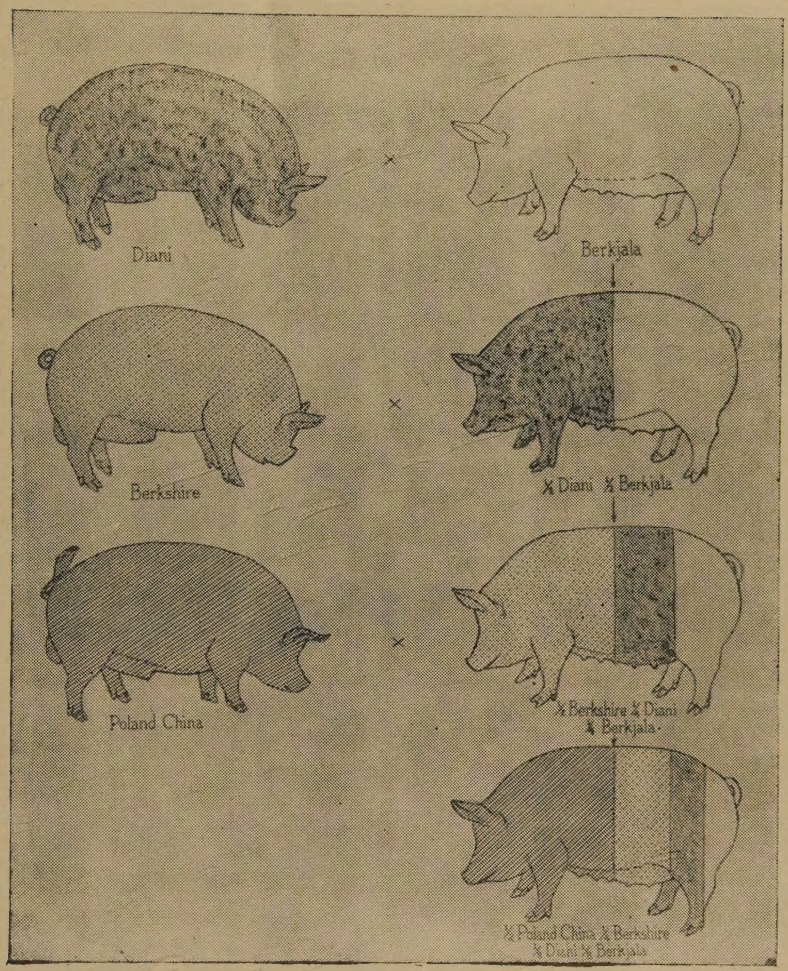

Fig. 2.—Triple crossing or three-way cross. The proportions of the blood of the different breeds in the offspring are shown.

In all these systems of crossbreeding, the object is to obtain hybrid vigor or unusual performance, called *heterosis* when two distinct breeds are bred to each other. The more intensely inbred and well-selected the parental animals are, the better will heterosis likely be in the progeny. Crossbreeding is beneficial and produces good stock, but it is expensive. Herds of at least two improved breeds have to be maintained. Inferior animals among the purebreds must always be culled if high-quality crossbreeds are to be produced.

Fig. 3.—Crisscrossing. The two breeds are used on the offspring alternately to obtain heterosis in each generation.

A new breed may be produced by first crossing two or more breeds. By selection and intelligent matings, certain points of the foundation breeds may be retained and established in the new breed. Important attributes should be the first concern of the breeder. Secondary points, such as color, size and position of ears, absence of swirls in pigs, etc., may be considered in a later operation. The purification and the establishment of a breed are relatively rapid with animals of short breeding cycles, such as poultry, swine, and sheep. The time can be shortened by using a large number of animals de-

viating as little as possible from the plan of matings and the points considered in the selection.

The Berkjala breed of swine (fig. 4) of the College of Agriculture, now a well-established breed, was started by crossing the Berk-

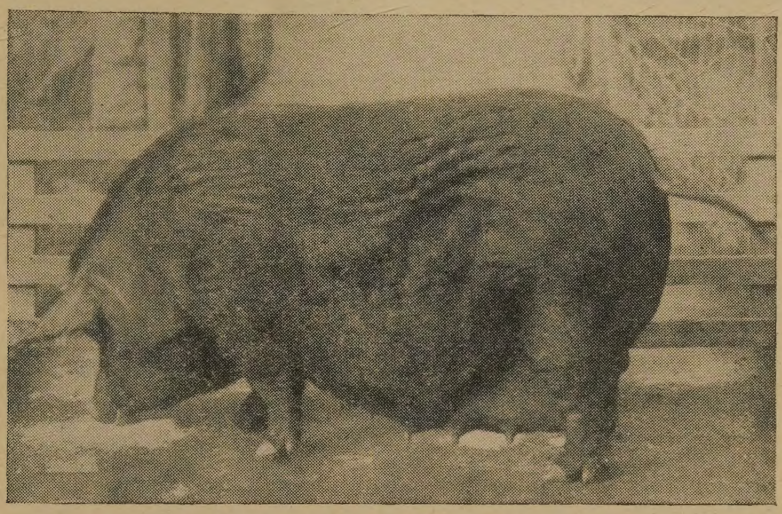

Fig. 4.—Berkjala sow produced by crossbreeding the Berkshire and the Jalajala strain of native pig and by selection and inbreeding among the progeny.

shire with the Jalajala strain of native pigs. Selection was based on six pigs at the first farrowing, seven at the second, and eight at the third and later farrowings; on the ability of the sow to raise three-fourths or more of the litter; and on the ability of the sow to raise the first litter to a total weight of at least 50 kilograms at weaning time, 60 kilograms on the second farrowing, and 80 kilograms on the third and subsequent farrowings.[3]

In the development of the Philamin beef-draft cattle, the three foundation breeds used were the Hereford, Nellore, and native breeds. The Hereford supplied size, conformation, fleshing ability, and early maturity. The Nellore imparted height, hardiness, resistance, and rustling ability. The native provided docility, adaptability, and fertility.

Except in the development of new breeds, crossbreeds should not be interbred promiscuously among themselves; otherwise the resulting offspring will exhibit a conglomeration of characteristics utterly lacking in uniformity. Such animals are slow to market and are sold at a discount.

[3] *Ibid.*

Grading is the mating of an improved breed with common or grade animals for the purpose of producing stock approaching the quality and performance of the improved breed (fig. 5). The im-

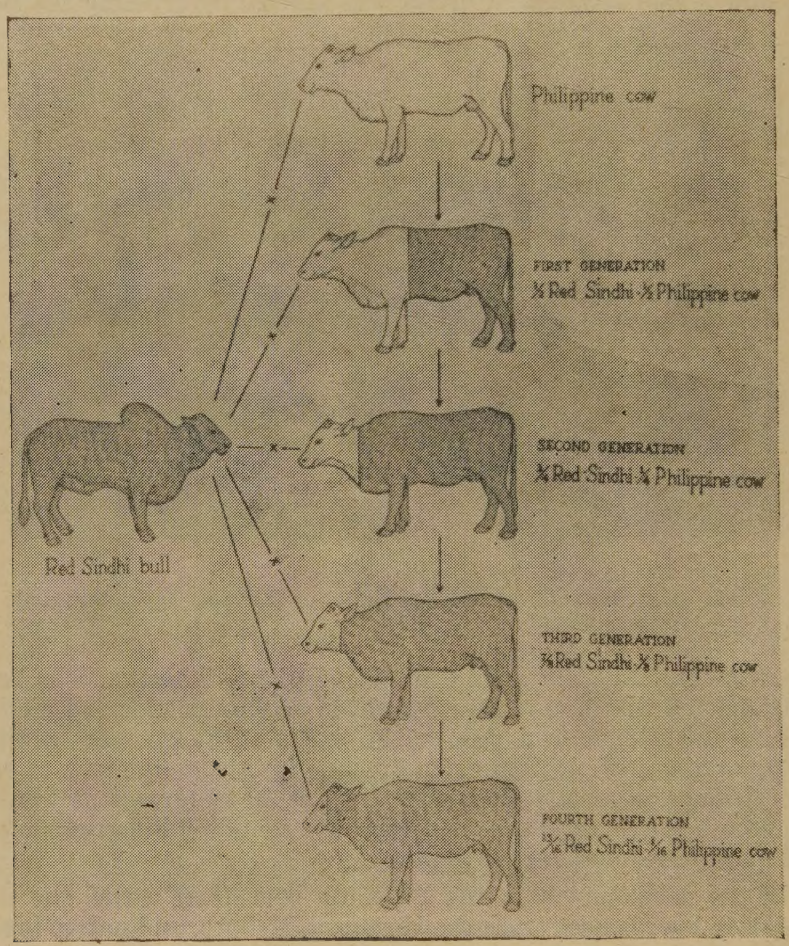

Fig. 5.—Grading. The amount of blood of the improved breed in the different generations of grades is indicated.

proved sire is crossed with females of the common stock. Then the female offspring which possess 50 per cent of the blood of the improved breed are bred by the sire of the same improved breed. This procedure is referred to as *topcrossing*. The result is progeny containing 75 per cent blood of the improved breed. To concentrate the better points of the superior breed, the work is repeated until the sixth or seventh generation when the grades become similar

to the improved breed. Using the female to represent the improved breed and the male, the common stock, retards the work.

Grading is popular in many ranches in this country. The Nellore breed of cattle, hardy, active on the range, and bigger than the native, is so far the breed usually used to improve the native stock. Unfortunately, Nellore cattle are also faulty in a number of ways. The animals have upstanding bodies, reach puberty late, and are hard to handle, easily becoming wild and unruly if not properly managed. Thus, although the objective is to accumulate the good characters of the Nellore in the grades or *mestizos*, at the same time many undesirable traits manifest themselves. For instance, grades having a high concentration of Nellore blood show such objectionable features as legginess and a wild disposition and vices like kicking.

Upon arrival in Manila from distant ranches, grade Nellores are gaunt and thin because of their refusal to feed normally in transit. The skin often is scratched and bruised as a result of injuries incurred while the animals are being moved from place to place. The crossbreds, which have 50 per cent each of the Nellore blood and native blood, are the heaviest and best fleshed of these grades. This is so because of the unusual vigor of crossbreeds.

To offset the ill effect of a high proportion of Nellore blood in the grades, the breeder should exercise care in selecting the bull. The body of the bull should be relatively deep and the fleshing thick. Individuals of bad disposition should not be considered for breeding.

The Red Sindhi is a dairy breed from Pakistan which thrives well in the Philippines. To a limited extent, it has been used for grading in this country with good results. The greater the proportion of Red Sindhi in the grade, the higher the milk production is expected to be.

The Murrah is a large-sized dairy breed of carabao from Pakistan with a milk production much greater than that of the native carabao. This breed is adapted to our environment. When mated with the native stock, as in grading, the offspring is improved in milk yield and in performance as a work animal, the crossbreeds being the best. The use of the Murrah carabao for such a purpose is highly recommended. Particular attention should be directed to the grading of native carabaos with this breed in regions where carabao milk and cheese are now produced commercially.

EFFECT OF TIME OF APPLYING AMMONIUM SULFATE ON GROWTH AND YIELD OF RICE [1]

J. R. VELASCO, B. A. NARIT,[2] AND D. B. FERNANDEZ [3]

Application of ammonium sulfate modified the trends of growth of Elon-elon and Inintiw for a limited period after treatment. The best results on tillering of both varieties were obtained when ammonium sulfate was applied at any time from planting to 45 days of age of the plants. The results indicate that rice plants need ammonium sulfate at the seedling stage, at mid-vegetative stage, and at late vegetative or early reproductive stage. Application of fertilizer during the early reproductive stage produced a high grain-to-straw ratio.

Interest in the proper timing of fertilizer application on rice started in this College with the late Dr. R. B. Espino. With his advanced classes in plant physiology, he determined the relative effects of different brands of fertilizers applied a few weeks before planting, at planting, and one month after planting. His experiments were based on the premise, which is still considered very sound, that the greatest need of the plant for available nutrients is at the seedling stage, when it is actively producing tillers and leaves. Some of the fertilizers had to be applied before planting to allow the conversion of the unavailable nutrients into available forms.

Unfortunately, the data which Dr. Espino accumulated were not published. The senior writer, who trained under Dr. Espino, continued the work and extended it to include the application of fertilizer during the late vegetative and early reproductive stages. The significant findings in this early trial prompted the senior author to assign the subject to his advanced students for verification. At the same time he ran further experiments to follow up the new leads that had been uncovered.

MATERIALS AND METHODS

The tuff of a Lipa clay loam soil was used as growth medium. The soil was pulverized, air-dried, pulverized again, and passed through a one-centimeter sieve. Seventeen kilograms of this soil were placed in tarred 5-gallon kerosene cans. Two grains of rice, spaced about twenty centimeters of each other, were planted in each can.

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[1] Central Experiment Station Contribution No. 1693. Based in part on the theses of the junior authors presented for graduation with the degree of Bachelor of Science in Agriculture, October, 1952, and April, 1953, respectively. Conducted in the Department of Agricultural Botany under the direction of the late Dr. R. B. Espino and afterwards under the senior author.

[2] Now with the Fertilizer Administration, Manila.

[3] Now with the Bureau of Soil Conservation, Manila.

Inintiw, an upland variety, was grown under typical upland conditions. Drainage holes were punched at the bottom of the cans so that no excess water would accumulate in them during the rainy season. During hot sunny days, water was added to the cultures so that the soil would be maintained at approximately 80 per cent saturation. Elon-elon, a lowland variety, was grown in supersaturated soil. The cans were made watertight, and about five centimeters of water was maintained above the soil surface.

Height of plants and number of tillers were recorded monthly in order to gauge the course of plant growth in the different cultures. The apparent height was taken by measuring the distance from a board placed on the lip of the can to the tip of the tallest leaf. The distance from the base of the plant to the board, which was considered constant, was added to the apparent height to get the actual height of the plant.

EXPERIMENTS AND RESULTS

Experiments with Elon-elon. The first experiment in this series was started on June 15, 1951. Four cultures consisting of four cans each were prepared. Culture I did not receive any fertilizer and served as the control. The plants in culture II were given 2 grams of ammonium sulfate (ca. 350 kg./ha.) at the age of 15 days. Culture III was given the same amount of fertilizer at the age of 32 days and culture IV, at the age of 153 days. In other words, culture II was fertilized in the seedbed, culture III, during or just after transplanting, and culture IV, at booting. The results were anticipated to shed light on the relative effects of applying the fertilizer during these three developmental stages.

The height of the plants and the number of tillers in each hill were taken every month. These criteria were chosen, not so much because they closely represented growth, but rather because data on them were easy to gather and the plants did not suffer from excessive handling. Increase in dry weight, the criterion which might indicate the course of growth more closely, entails more labor and facilities which were not obtainable during these experiments. Besides, such a criterion may be of doubtful value in actual field practice.

In general, the greatest increase in height was attained during the first month of growth (table 1). Relatively rapid growth was maintained until the plants were 61 days old. During the third and fourth months growth was relatively slow; thereafter growth became rapid again although it did not equal half of the growth of the first month. This later increase coincided with flower emergence. The application of fertilizer increased the rate of growth temporarily and modified the general pattern of growth of the plant.

The monthly tiller counts (table 2) showed a general increase until the plants were 61 days old and a gradual decrease thereafter.

The decrease was due to the drying up of some tillers. Fertilization at 15 days and at 32 days of age (cultures II and III) markedly increased the tillers. Although the highest average number of tillers in culture II was 2.6 times that in the control (cuture 1), the average number of panicles in culture II was only 1.6 times that in culture I. This indicates that relatively more tillers in the fertilized lot failed to reach bearing age than in the unfertilized lot.

The plants were harvested on January 2, 1952. The yield to a can showed that culture II produced, on the average, a little more than twice the control (culture I), whereas culture III produced about 1.8 times as much (table 3). The poorest results were obtained from culture IV, which was fertilized at booting.

Great variability was noticed among plants within each culture. For example, two cans in culture II produced practically one-half of the grain yield of the other two cans; in cultures III and IV the yield of one can each was much more than those of the other three cans; and in culture I variability was highest. This would suggest that some other primary factor, not associated with the fertilizer, dominantly influenced the plants.

Another experiment in this series was started on July 18, 1951. Two sixteen-day-old seedlings were transplanted in each can. Ammonium sulfate at the rate of 1.5 grams a can or 200 kilos a hectare was applied at different times to the cultures of six cans each. Culture I was not fertilized; cultures II, III, IV, V, and VI were fertilized on August 17, September 17, October 17, November 17, and November 27, respectively. On November 27, the plants were noticeably at the booting stage.

The height of the plants and number of tillers were taken every two weeks. Growth in height was again quite rapid during the seedling stage until the plants were 68 days old (table 4). Then followed a period of relatively slow growth until the plants were 138 days of age and a period of rapid growth coinciding with flower emergence. The influence of the fertilizer was shown in the increased growth within a limited period after its application. This influence was superimposed on the general trend of growth of the rice plants.

There was a general increase in number of tillers until the plants were 67 days old (table 5). Beyond this period, the increase gradually slackened. The good effect of the fertilizer on tillering was very marked among plants which were fertilized at 45 days of age (culture II). Fertilization later than at the age of 76 days did not increase the tillers.

Most of the plants were attacked by rats so that not much importance can be attached to the data on grain yield (table 6). It may be noted, however, that the highest number of panicles was obtained when fertilizer was applied at 45 days of age of the plants and the heaviest grain yield, when fertilizer was applied at 106 days of age.

The third experiment, which was started on August 6, 1952, was a repetition of the first two experiments with attention given to the important indications that were found. The repetition was especially necessary because the yield in the first experiment was very variable and that in the second experiment was attacked by rats. Culture I was not fertilized. Cultures II, III, IV, V, and VI were fertilized on August 12, September 9, October 9, November 10, and December 10, respectively. In order to combine the good effect on tillering of fertilization during the seedling stage and the good effect on grain yield of fertilization when the plants are 100 day old, three pots in culture II (designated here as IIa) were given a second application on November 14.

Again, data on height of plants and number of tillers were gathered every month, and the yield of grains was obtained at harvest. In cultures IV, V, and VI the height and the number of tillers were taken only after the application of fertilizer. It was assumed that growth before the application was similar to that of the control.

The pattern of increase in height observed in the first two cultures was roughly confirmed in the third culture. There was rapid growth during the first 65 days of life of the plant (table 7), then a slowing down thereafter. The increase in growth at flower emergence was not pronounced in some of the cultures.

The plants in the first three pots of culture II received one application of ammonium sulfate at six days of age. The plants in the next three pots, which received ammonium sulfate at 100 days of age in addition to the amount applied to it at six days of age, were, however, much taller than the plants in the other cultures. Except in culture VI, fertilizer had an immediate effect in terms of increased height of the plants.

For favorable results on tillering, the best time of application was at six days of age of the plants (table 8). Tillering reached its maximum in most cultures when the plants were 99 days old.

The highest average grain yield was obtained in culture IIa (table 9) which received twice as much fertilizer as the other fertilized lot. The difference in grain yield between cultures I and II (12.8 grams) may be traced to the application of 200 kg./ha. of ammonium sulfate to culture II during the seedling stage. The difference between cultures II and IIa (14.3 grams) was due to the second application of fertilizer to culture IIa at 100 days of age. Of the single applications of fertilizer, the one at the seedling stage (culture II) gave the best return. The application at approximately one hundred days of the plants (culture V) also produced a fairly high yield. The results serve to emphasize the need for an adequate supply of nitrogen at these stages.

Since the most useful part of the rice plant is the grain, it would be most economical if the plant were to produce more grains and less

straw. Effort should then be exerted to modify the plant so that the grain-to-straw ratio will be in favor of the grain. Timing the application of ammonium sulfate seems to be one good approach towards this end. While the unfertilized plants (culture I) had a grain-to-straw ratio of 1:3.51, plants fertilized at approximately 100 days of age had ratios of 1:1.80 (culture IIa) and 1:1.79 (culture V). Fertilization at other stages produced plants of intermediate grain-to-straw ratio.

Experiments with Inintiw. The first experiment in this series was planted on June 15, 1951. Culture I did not received any fertilizer. Cultures II, III, and IV were fertilized at 15 days, 32 days and 75 days of age, respectively. At 75 days the plants were visibly booting.

The general trend of growth of Inintiw (table 10) differed from that of Elon-elon in that there was no slackening of increase in height during the late vegetative stage. It is probable that the period of diminished growth lay well within the interval between any two periods of observation and passed undetected. Since there would not be much advantage in knowing that such a slackening of growth exists in Inintiw, this probability was not explored. All the fertilized plants had a final average height which was greater than that of the unfertilized plants. The tallest plants were those of culture IV which received the fertilizer at the booting stage. As in Elon-elon, the application of the fertilizer was reflected in the subsequent increase in height of the plants.

Tillering reached its maximum at 61 days of age of the plants (table 11); there was a decrease of tillers towards maturity. The fertilizer was most beneficial to tillering when applied any time during the first month of life of the plant.

The highest average grain yield was obtained from culture III (table 12) which was fertilized at 32 days of age. In spite of the relatively greater number of tillers in culture II than in cultures I and IV, the latter had higher grain yields, indicating that they had heavier panicles. It is of further interest that culture III produced the lowest grain-to-straw ratio. As in Elon-elon a better plant economy can be attained by properly timing the application of ammonium sulfate.

In the second experiment begun on May 21, 1952, culture I was not fertilized; cultures II, III, and IV were fertilized at 12 days of age with ammonium sulfate at the computed rate of 170 kg./ha. In addition, culture III received a second application of the same rate at 81 days and culture IV, at 91 days. The plants were booting at 81 days and the heads emerged at 91 days.

The general trend of growth in height (table 13) was similar to that in the preceding experiment and slightly different from that observed in Elon-elon. Application of ammonium sulfate at the different ages noticeably increased the growth in height.

The effect of the fertilizer on tillering was essentially the same as in the previous experiment; it increased tillering when applied at the seedling stage, but not when applied at booting or flowering.

The highest yield of grain was obtained from culture III which was fertilized at 6 and 81 days of age (table 14). The difference in grain yield between cultures I and II represents the increase in yield due to the application of ammonium sulfate to culture II at six days of age. The difference between cultures II and III represents the increase due to fertilization of culture III at 81 days of age. It will be noted that the increase due to the second application was more than twice the increase due to the first application. It should however be mentioned that the interaction between the first and the second application was entirely left out and the picture as presented is oversimplified. Application at 91 days of age of the plants produced an increment which was practically one-half of that from application at six days. The grain-to-straw ratio was greatly improved by the application of the fertilizer at the booting stage.

DISCUSSION

The indication in these experiments is that rice plants need a liberal supply of nitrogenous fertilizer at three critical stages in their development: (1) during the seedling stage when the plants are actively producing tillers and leaves, (2) at mid-vegetative stage to prevent drying of the tillers, and (3) at late vegetative or early reproductive stage for the production of big panicles and heavy grains. With Elon-elon, the first stage ends at approximately forty days of age; the second stage is at around sixty days of age; and the third stage is at 100 days. With Inintiw, the first stage ends at 30 days of age, the second at 60 days, and the third probably at 80 days. The possibility of the third stage in Inintiw being identical with the second is being explored in another experiment.

Recently, a report on rice fertilization in Japan [4] came to one of the writers' attention. The Japanese farmers apply 50 to 100 lb. of nitrogen and 70 to 80 lb. each of phosphoric acid and potash to an acre, or approximately the same figures in kilos a hectare. They supply two-thirds of the mixture just before puddling; one-sixth, about three to four weeks after transplanting; and one-sixth, two to three weeks before ear emergence. Walker and Sturgis [5] recommended for Louisiana a split application of 300 lb. to an acre of 0-16-0, 3-9-6, or 3-12-12 fertilizer with or under the seed at planting followed by 24 to 32 lb. an acre of nitrogen as top dressing before the booting stage.

[4] K. Ramiah and M. V. Vachhani, *The Mysore Agric. Jour.* [1] 29, 12 (1953).

[5] R. K. Walker and M. R. Sturgis, *Ann. Rept. of the Agric. Exper. Sta., Louisiana State University, Agric. and Mechanical Coll., Baton Rouge 1947-1948,* 45 (1948).

The grain-to-straw ratio deserves more attention than has been given to it. It may serve as a good criterion of the effectiveness of a fertilizer treatment or a guide as to what fertilizer program to adopt for the succeeding year's crop.

The data on height of plants and number of tillers were gathered in the hope of deducing some generalization which might serve as a guide in forecasting crop yield. This angle is still being studied.

TABLE 1

Height of Elon-elon rice plants fertilized with 350 kg./ha. of ammonium sulfate at different ages [a]

CULTURE NO.	AGE	HEIGHT IN CENTIMETERS								AVERAGE
		Repl. 1		Repl. 2		Repl. 3		Repl. 4		
		a	b	a	b	a	b	a	b	
	31	43	46	46	44	46	48	39	45	44.6
	61	67	68	57	61	59	58	57	57	60.5
I [b]	92	71	72	70	71	71	71	70	68	70.5
	123	78	81	74	80	80	78	79	74	78.0
	153	95	98	83	81	93	92	87	84	89.1
	31	57	47	45	54	52	53	53	50	51.3
	61	70	62	63	68	73	69	64	62	66.3
II	92	81	72	69	73	78	76	75	70	74.2
	123	93	79	76	75	88	87	84	81	82.8
	153	103	89	81	86	108	107	94	84	94.0
	31	43	40	41	51	26	48	50	45	43.0
	61	78	69	68	75	62	76	76	73	72.1
III	92	78	73	68	87	63	78	89	83	77.5
	123	88	72	77	95	70	90	97	90	84.8
	153	92	68	82	97	80	109	108	108	93.0
	31	39	40	42	46	45	17	39	41	37.7
IV	61	57	61	58	59	60	45	53	51	55.5
	92	72	63	61	72	72	57	62	70	67.8
	123	80	74	70	81	81	67	74	78	75.6
	153	83	88	78	111	95	72	74	80	85.1

[a] Planted June 15, 1951; harvested January 2, 1953.

[b] Culture I, no fertilizer; cultures II, III, and IV fertilized at 15, 32, and 153 days of age, respectively.

TABLE 2

Tiller counts of Elon-elon rice plants

CULTURE NO.	AGE IN DAYS	HEIGHT IN CENTIMETERS								AVERAGE
		Repl. 1		Repl. 2		Repl. 3		Repl. 4		
		a	b	a	b	a	b	a	b	
	31	4	4	5	8	5	5	4	5	5.0
	61	12	11	8	9	11	10	7	8	9.5
I	92	11	11	7	9	10	10	7	7	9.0
	123	9	8	5	6	7	6	6	6	6.6
	153	9	8	4	6	7	6	6	5	6.3
	201	9	7	2	4	7	6	5	5	5.6
	31	21	7	7	10	14	12	13	8	11.5
	61	36	13	24	30	20	22	23	18	23.2
II	92	36	14	14	26	18	19	22	14	20.3
	123	22	7	6	12	11	11	9	9	10.8
	153	21	6	6	8	11	11	9	7	9.8
	201	17	6	5	7	10	11	9	7	9
	31	5	4	5	8	1	5	9	9	5.7
	61	27	5	15	25	9	28	30	24	20.3
III	92	24	4	13	21	7	25	25	21	17.5
	123	13	3	9	12	5	12	16	12	10.2
	153	11	1	8	11	4	10	13	11	8.6
	201	11	0	5	11	3	10	13	10	7.8
	31	3	2	4	8	3	1	4	5	3.7
	61	9	7	6	13	10	2	8	10	8.1
IV	92	9	6	6	12	10	2	8	9	7.7
	123	5	4	4	9	8	2	5	6	5.3
	153	5	4	4	9	7	2	5	5	5.1
	201	5	4	4	7	4	0	3	3	3.7

TABLE 3

Yield of grains

CULTURE NO.	REPLICATION	WT. OF GRAINS IN GRAMS	NO. OF PANICLES	WEIGHT PER PANICLE
I	1	14.5	10	1.45
	2	24.2	13	1.86
	3	3.5	6	.58
	4	23.1	16	1.44
	Average	16.4		
II	1	26.0	16	1.62
	2	44.0	21	2.09
	3	23.5	12	1.96
	4	43.5	23	1.89
	Average	34.2		
III	1	53.9	23	2.32
	2	22.6	13	1.74
	3	19.8	16	1.24
	4	18.6	11	1.69
	Average	28.7		
IV	1	5.9	9	.65
	2	8.0	4	2.00
	3	17.4	11	1.58
	4	9.4	6	1.57
	Average	10.1		

TABLE 4

Height of Elon-elon rice plants fertilized with 200 kg./ha. at different ages [a]

CULTURE NO.	AGE IN DAYS	HEIGHT IN CENTIMETERS						AVERAGE
		Repl. 1		Repl. 2		Repl. 3		
		a	b	a	b	a	b	
	54	37.6	47.8	55.3	51.0	47.7	46.1	47.5
	68	51.0	53.6	65.0	62.0	62.0	59.0	48.8
	82	56.5	57.1	59.9	60.3	65.9	60.7	60.1
	96	57.1	65.8	67.4	76.8	69.8	65.5	67.1
I [b]	110	64.0	66.5	72.0	77.9	79.1	79.9	73.2
	124	72.0	70.6	78.0	81.2	84.0	72.4	76.4
	138	83.3	80.5	85.1	86.4	86.5	76.8	83.1
	153	90.1	95.6	102.5	99.9	90.5	89.8	94.7
	168	106.0	113.5	126.1	123.7	120.6	114.7	117.4
	54	53.1	47.8	58.0	64.4	52.6	55.1	55.2
	68	58.8	57.7	67.4	74.1	66.2	65.7	65.0
	82	63.6	59.1	66.0	74.0	64.2	62.9	65.0
	96	71.2	70.8	75.6	72.4	74.9	79.5	74.1
II	110	79.0	77.5	81.2	80.2	85.9	80.8	80.8
	125	82.0	77.5	83.3	82.6	86.0	82.0	82.2
	138	90.6	81.8	91.4	85.4	95.0	82.0	87.7
	153	116.5	94.5	104.0	103.8	108.5	90.9	103.0
	168	130.9	118.6	117.2	115.9	127.8	120.3	121.8
	54	42.2	56.5	36.1	39.8	44.1	40.2	43.2
	68	57.6	60.5	59.3	59.4	62.8	59.6	59.8
	82	65.0	63.3	61.7	63.2	66.1	65.6	64.2
	96	96.1	96.1	90.2	94.2	91.3	89.0	92.8
III	110	97.3	98.0	90.5	95.3	92.2	89.2	93.8
	125	87.4	94.4	91.0	90.4	92.7	89.4	90.8
	138	100.5	96.6	99.0	99.3	99.9	99.3	99.1
	153	117.2	97.3	104.0	104.0	104.0	98.4	104.2
	168	132.4	119.1	130.9	132.5	124.4	126.5	127.6
	54	48.5	48.9	45.7	49.7	44.3	52.6	48.3
	68	50.8	52.3	54.6	59.6	57.0	69.1	57.2
	82	57.2	52.2	54.6	59.4	57.3	68.4	58.2
	96	62.3	58.6	56.1	64.7	64.2	70.6	62.8
IV	110	69.0	62.9	69.3	76.9	81.7	80.1	73.3
	124	96.1	90.7	95.0	97.9	102.0	101.6	97.2
	138	101.2	95.8	101.5	105.1	107.8	108.5	103.3
	153	112.0	101.9	111.7	111.4	119.8	112.3	111.5
	168	131.8	124.9	135.6	133.4	126.0	129.8	130.2
	54	53.2	49.9	47.1	37.6	49.6	46.0	47.2
	68	55.4	54.0	60.2	53.5	58.9	61.3	57.2
	82	54.1	53.0	63.2	54.2	60.4	62.0	57.8
	96	62.2	60.5	70.7	58.1	67.2	70.0	64.8
V	110	70.2	64.0	79.1	63.0	73.2	71.6	70.2
	124	72.2	71.3	84.0	67.4	77.5	78.3	75.1
	138	80.0	82.8	94.2	76.3	85.3	90.0	84.8
	153	109.3	104.4	110.1	103.6	110.5	121.0	109.8
	168	131.5	136.7	127.4	130.6	135.3	138.9	133.4
	54	41.0	49.3	52.3	46.0	47.6	40.5	46.1
	68	54.4	59.5	57.7	54.6	57.3	56.2	56.6
	82	54.0	59.0	60.0	54.3	59.8	61.2	58.1
	96	62.0	61.8	69.5	59.2	68.5	73.2	65.7
VI	110	65.3	66.4	74.0	65.4	71.7	73.2	69.3
	124	69.0	70.7	75.7	74.4	75.1	74.0	73.2
	138	89.0	105.4	101.3	88.2	95.6	86.5	94.3
	168	124.0	132.4	126.0	120.7	125.1	102.5	121.7

[a] Planted July 2, 1951; harvested February 2, 1952.

[b] Culture I, no fertilizer; cultures II, III, IV, V, and VI fertilized at 46, 77, 107, 138, and 148 days of age, respectively.

TABLE 5

Number of tillers

CULTURE NO.	AGE IN DAYS	Repl. 1		Repl. 2		Repl. 3		AVERAGE
		a	b	a	b	a	b	
	54	8	8	9	9	6	7	7.8
	68	8	9	10	8	8	7	8.3
	82	8	9	9	8	9	7	8.3
	96	8	9	10	7	8	7	8.2
I	110	7	9	9	6	8	7	7.7
	124	7	7	7	6	8	6	6.8
	138	7	7	6	5	7	6	6.3
	153	7	6	6	5	6	6	6.0
	168	6	6	6	5	6	6	5.8
	54	11	6	10	10	13	5	9.2
	68	16	15	25	11	17	22	17.7
	82	15	12	22	10	16	21	16.0
	96	13	12	21	10	16	17	14.8
II	110	10	9	15	8	14	14	10.0
	124	10	8	12	7	8	12	9.5
	138	8	7	10	7	7	12	8.5
	153	7	7	10	7	7	11	8.2
	168	6	6	9	7	6	11	7.5
	54	8	8	3	5	7	4	5.8
	68	10	13	4	9	7	7	8.3
	82	11	13	7	9	10	7	9.5
	96	11	12	12	15	17	10	12.0
III	110	9	12	10	14	16	10	11.8
	124	8	10	8	11	12	8	12.8
	138	6	9	5	9	7	7	7.2
	153	5	9	5	9	7	7	7.0
	168	5	9	4	9	7	7	6.8
	54	9	4	9	7	5	8	7.0
	68	12	5	10	9	8	10	9.0
	82	12	5	9	9	8	10	8.8
	96	10	5	10	8	6	9	8.0
IV	110	9	5	8	8	6	9	7.5
	124	8	4	8	6	5	8	6.5
	138	6	4	7	6	5	8	6.0
	153	6	4	6	5	3	8	5.3
	168	6	4	6	4	3	8	5.1
	54	9	9	13	5	10	5	8.5
	68	10	11	15	8	11	5	10.0
	82	10	11	13	7	11	7	9.8
	96	10	11	12	7	10	7	9.5
V	110	9	10	11	7	9	7	8.8
	124	7	6	11	5	8	5	7.0
	138	7	6	8	4	8	4	6.2
	153	7	6	7	4	8	4	6.0
	168	6	5	6	5	7	4	5.5
	54	4	8	9	7	4	10	7.0
	68	7	11	11	7	6	14	9.3
	82	8	11	11	8	6	12	9.3
	96	8	11	11	7	6	13	9.3
VI	110	7	10	10	6	6	11	8.3
	124	6	8	10	5	6	11	7.7
	138	5	2	9	5	5	10	6.0
	153	4	7	9	5	5	10	6.7
	168	3	2	9	6	6	5	5.1

TABLE 6

Yield of grains in grams

CULTURE NO.	HILL NUMBER	HARVESTED PANICLES	FILLED GRAINS	UNFILLED GRAINS
I	7[a]	6	12.6[a]	0.3
	8	6	16.8	0.8
	9	6	16.6	0.4
	10	5	16.1	0.4
	11	6	12.7	0.9
	12	6	11.6	0.4
	Average	5.8	14.4	0.53
II	7[a]	6	17.7	0.2
	8	6	13.4	0.1
	9	9	20.4	0.5
	10	7	12.4	0.4
	11	6	13.5	0.2
	12	11	21.9	0.6
	Average	7.5	16.5	0.3
III	7[a]	5	16.8	0.7
	8	9	20.4	1.4
	9[a]	4	9.4	0.2
	10[a]	9	21.3	0.8
	11	7	20.9	1.0
	12	7	17.2	0.8
	Average	6.8	17.7	0.8
IV	7	6	24.5	1.5
	8[a]	4	10.7	0.3
	9[a]	6	19.6	2.1
	10	4	18.7	1.6
	11	3	14.9	1.7
	12	8	28.1	1.4
	Average	5.1	19.4	1.4
V	7[a]	6	20.8	1.3
	8	5	16.5	0.6
	9	6	19.7	0.6
	10[a]	5	14.5	0.8
	11	7	24.1	1.4
	12[a]	4	18.4	2.0
	Average	5.5	19.0	1.1
VI	7[a]	3	10.9	0.4
	8[a]	2	9.3	0.7
	9[a]	9	24.8	3.4
	10[a]	6	12.5	0.3
	11[a]	6	30.0	0.3
	12	5	13.2	2.0
	Average	5.1	16.8	1.2

[a] Panicles partially damaged by rats.

TABLE 7

Height of Elon-elon rice plants fertilized with 200 kg./ha. of ammonium sulfate at different ages[a]

CULTURE NO.	AGE	HEIGHT IN CENTIMETERS												AV.
		Repl. 1		Repl. 2		Repl. 3		Repl. 4		Repl. 5		Repl. 6		
		a	b	a	b	a	b	a	b	a	b	a	b	
	35	26	31	23	30	34	36	30	29	34	34	32	31	30.8
I[b]	65	59	60	55	60	54	53	55	56	59	59	55	57	56.8
	99	60	63	57	62	58	58	57	62	63	63	58	58	59.9
	127	69	78	69	79	68	66	68	74	78	74	72	73	72.3
	35	48	44	49	44	43	43	—	—	—	—	—	—	45.1
II	65	68	69	71	68	69	69	—	—	—	—	—	—	69.0
	99	77	80	81	76	73	78	—	—	—	—	—	—	77.5
	127	92	90	93	93	92	93	—	—	—	—	—	—	92.1
	35	—	—	—	—	—	—	41	40	40	42	42	41	41.0
IIa	65	—	—	—	—	—	—	71	61	69	69	68	64	67.0
	99	—	—	—	—	—	—	80	68	79	81	74	72	75.7
	127	—	—	—	—	—	—	118	107	116	119	115	103	113.0
	35	33	33	29	34	23	30	35	32	36	33	33	33	23.7
III	65	65	63	68	71	63	65	69	66	68	67	65	63	66.0
	99	79	70	69	75	76	78	77	69	73	77	67	60	71.6
	127	82	78	79	90	88	75	83	85	81	88	85	78	82.6
	35	—	—	—	—	—	—	—	—	—	—	—	—	(30.8)
IV	65	60	57	59	63	66	70	62	60	64	60	62	61	62.0
	99	75	74	71	75	80	85	81	88	88	76	77	74	70.3
	127	81	82	83	77	91	97	88	87	92	81	83	84	85.5
	35	—	—	—	—	—	—	—	—	—	—	—	—	(30.8)
V	65	—	—	—	—	—	—	—	—	—	—	—	—	(57.0)
	99	66	75	75	70	85	71	78	72	74	72	73	83	74.5
	127	94	96	94	89	101	85	94	87	89	92	85	94	91.6
	35	—	—	—	—	—	—	—	—	—	—	—	—	(30.8)
VI	65	—	—	—	—	—	—	—	—	—	—	—	—	(57.0)
	99	—	—	—	—	—	—	—	—	—	—	—	—	(64.5)
	127	60	75	68	78	85	79	76	72	69	77	68	67	72.8

[a] Planted August 6, 1952; harvested February 18, 1953.

[b] Culture I, no fertilizer; cultures II, III, IV, V, and VI fertilized at 12, 34, 64, 96, and 126 days of age, respectively; and culture IIa fertilized at 12 and at 100 days.

TABLE 8

Tiller counts of Elon-elon rice plants

CULTURE NO.	AGE IN DAYS	HEIGHT IN CENTIMETERS												AV.
		Repl. 1		Repl. 2		Repl. 3		Repl. 4		Repl. 5		Repl. 6		
		a	b	a	b	a	b	a	b	a	b	a	b	
	35	1	1	1	1	1	1	1	1	1	1	1	1	1.0
	65	7	8	4	5	3	4	4	4	6	6	5	6	5.6
I	99	5	7	4	6	5	5	4	3	5	6	6	6	5.2
	127	2	6	2	6	3	4	4	3	4	3	4	4	3.7
	35	3	3	4	3	3	3	—	—	—	—	—	—	3.1
	65	16	12	15	10	14	12	—	—	—	—	—	—	13.1
II	99	14	11	17	13	16	13	—	—	—	—	—	—	14.0
	127	6	6	10	5	7	7	—	—	—	—	—	—	7.0
	35	—	—	—	—	—	—	3	2	3	3	3	3	2.8
	65	—	—	—	—	—	—	13	10	13	18	12	8	12.3
IIa	99	—	—	—	—	—	—	15	11	16	18	13	13	14.3
	127	—	—	—	—	—	—	10	6	7	10	8	8	8.1
	35	1	1	1	1	1	1	2	1	1	1	1	1	1.0
	65	16	11	6	11	9	12	7	9	10	11	8	10	10.0
III	99	12	10	8	15	13	13	12	11	11	11	11	13	11.6
	127	6	6	4	7	4	7	3	5	7	5	5	2	5.1
	35	—	—	—	—	—	—	—	—	—	—	—	—	(1.0)
	65	8	7	12	6	6	11	7	4	8	10	6	9	7.8
IV	99	13	14	17	11	8	12	10	8	11	12	13	13	12.6
	127	5	5	3	2	4	5	4	3	3	4	6	4	4.0
	35	—	—	—	—	—	—	—	—	—	—	—	—	(1.0)
	65	—	—	—	—	—	—	—	—	—	—	—	—	(5.1)
V	99	4	5	10	3	11	6	6	6	8	9	11	8	7.2
	127	3	2	8	3	5	3	3	2	4	7	3	6	4.0
	35	—	—	—	—	—	—	—	—	—	—	—	—	(1.0)
	65	—	—	—	—	—	—	—	—	—	—	—	—	(5.1)
VI	99	—	—	—	—	—	—	—	—	—	—	—	—	(5.1)
	127	3	3	3	5	3	4	3	4	3	3	3	2	3.2

TABLE 9

Yield of grain and straw in grams of Elon-elon rice plants

CULTURE NO.	REPLICATION	WT. OF GRAINS	NO. OF PANICLES	WT. PER PANICLE	WT. OF STRAW	GRAIN: STRAW RATIO
I	1	6.5	2	3.25	18.2	
	2	6.7	7	0.95	21.6	
	3	6.4	5	1.25	11.9	
	4	1.7	2	0.85	13.1	
	5	2.5	3	0.85	15.0	
	6	3.6	4	0.90	16.3	
	Average	4.57	3.53	1.341	16.02	1:3.51
II	1	16.6	12	1.38	44.1	
	2	17.6	11	1.60	44.8	
	3	17.9	13	1.38	33.9	
	Average	17.4	12	1.453	40.93	1:2.35
IIa	1	30.4	16	1.87	56.1	
	2	36.1	17	2.06	57.9	
	3	28.7	15	1.90	57.1	
	Average	31.7	16	1.94	57.03	1:1.80
III	1	12.0	9	1.33	32.0	
	2	12.0	12	1.00	36.4	
	3	13.6	10	1.36	42.3	
	4	10.1	7	1.44	32.2	
	5	16.2	12	1.35	34.7	
	6	11.0	7	1.57	27.5	
	Average	12.48	9.5	1.34	34.18	1:2.74
IV	1	12.9	9	1.43	32.5	
	2	15.5	8	1.94	28.3	
	3	14.5	8	1.81	28.7	
	4	7.7	4	1.92	29.0	
	5	8.1	7	1.16	34.7	
	6	13.0	9	1.45	29.5	
	Average	11.95	7.5	1.62	30.45	1:2.55
V	1	17.3	11	1.57	36.3	
	2	13.4	8	1.67	32.0	
	3	16.8	9	1.86	25.3	
	4	16.2	9	1.80	24.3	
	5	20.4	10	2.04	34.4	
	6	10.5	3	3.50	17.3	
	Average	15.77	8.33	2.07	28.27	1:1.79
VI	1	12.2	8	1.52	20.5	
	2	12.7	10	1.27	25.6	
	3	8.0	4	2.00	16.8	
	4	13.8	7	1.97	18.7	
	5	13.1	8	1.64	23.4	
	6	7.9	10	.79	30.4	
	Average	11.28	7.83	1.53	22.57	1:2.00

TABLE 9a

Analysis of variance of weight of grains

SOURCES OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F-VALUE	
				Computed	Tabular
Treatment	6	1601.81	266.97	34.2	2.43
Error	29	226.57	7.81		3.50
Total	35	1828.38			

LSMD = 3.58

TABLE 10

Height of Inintiw rice plants fertilized with 350 kg./ha. of ammonium sulfate at different ages [a]

CULTURE NO.	AGE IN DAYS	HEIGHT IN CENTIMETERS								AVERAGE
		Repl. 1		Repl. 2		Repl. 3		Repl. 4		
		a	b	a	b	a	b	a	b	
I [b]	31	43	42	37	39	45	50	38	41	41.8
	61	86	86	67	68	82	83	68	64	75.5
	92	117	123	88	107	125	124	109	108	112.6
II	31	45	50	49	57	59	54	51	27	49.0
	61	75	81	102	96	81	84	93	70	85.2
	92	108	121	121	128	121	110	126	123	119.7
III	31	46	44	54	45	42	50	36	47	45.7
	61	92	96	105	90	99	98	98	77	94.3
	92	121	122	113	127	130	133	123	114	122.8
IV	31	43	50	46	48	44	45	31	49	44.5
	61	87	89	79	82	82	82	72	54	78.3
	92	134	130	121	122	134	135	127	110	126.6

[a] Planted June 15, 1951; harvested October 6, 1951.

[b] Culture I, no fertilizer; cultures II, III, and IV, fertilized at 15, 32, and 75 days of age, respectively.

TABLE 11

Tiller counts of Inintiw rice plants

CULTURE NO.	AGE IN DAYS	HEIGHT IN CENTIMETERS								AVERAGE
		Repl. 1		Repl. 2		Repl. 3		Repl. 4		
		a	b	a	b	a	b	a	b	
	31	8	7	2	5	8	8	5	5	6.0
I	61	20	17	5	10	16	14	9	9	12.5
	92	12	13	3	8	11	11	8	8	9.2
	31	8	10	10	18	10	9	10	5	10.0
II	61	12	18	23	19	16	18	30	17	19.1
	92	10	12	13	17	11	7	20	13	12.8
	31	6	8	8	5	6	15	5	7	7.5
III	61	20	25	21	11	15	10	20	13	16.9
	92	17	14	8	9	28	12	12	10	13.7
	31	8	9	5	8	7	5	3	5	6.2
IV	61	15	13	12	12	10	14	8	7	11.3
	92	11	11	9	8	7	9	8	6	8.6

TABLE 12

Yield of grain and straw in grams of Inintiw rice plants

CULTURE	REPLICATION	WT. OF GRAINS	NO. OF PANICLES	WT. PER PANICLE	WT. OF STRAW	GRAIN : STRAW RATIO
	1	50.6	25	2.02	66	
I	2	20.4	11	1.81	96	
	3	46.3	21	2.20	61	
	4	23.7	16	1.48	76	
	Average	35.25	18.2		74.75	1:2.12
	1	27.5	21	1.31	97	
II	2	39.2	28	1.40	52	
	3	18.7	18	1.04	83	
	4	47.5	29	1.64	42	
	Average	33.23	24.0		68.5	1:2.06
	1	51.3	29	1.77	80	
III	2	28.6	16	1.79	61	
	3	60.6	39	1.56	61	
	4	33.0	18	1.83	39	
	Average	43.38	25.5		60.25	1:1.39
	1	52.2	21	2.49	115	
IV	2	38.2	18	2.14	66	
	3	40.0	15	2.66	130	
	4	22.4	13	1.72	117	
	Average	38.20	16.8		107	1:2.80

TABLE 13

Monthly measurements of the height of plants [a]

CULTURE NO.	AGE IN DAYS	HEIGHT IN CENTIMETERS								AVERAGE
		Repl. 1		Repl. 2		Repl. 3		Repl. 4		
		a	b	a	b	a	b	a	b	
	31	46.2	47.1	49.2	51.7	51.1	52.0	49.2	48.4	49.36
I [b]	61	60.0	55.4	62.1	65.3	64.4	58.2	66.6	62.5	61.81
	92	73.4	71.5	89.2	78.4	91.0	82.6	79.8	85.3	81.40
	123	94.0	94.9	98.7	93.5	109.2	114.7	108.9	94.1	101.00
	31	50.8	51.0	33.6	42.4	53.0	51.6	52.4	55.2	48.75
II	61	66.9	64.6	58.1	64.0	72.3	74.8	66.1	68.9	66.96
	92	89.6	82.4	84.1	88.1	94.8	90.1	79.0	82.2	86.29
	123	108.6	105.6	112.5	102.6	111.9	111.7	99.5	98.7	106.39
	31	62.8	51.3	45.7	52.9	52.8	50.3	53.8	52.8	52.80
III	61	76.2	66.2	70.7	62.2	72.4	70.8	66.2	68.5	69.15
	92	92.1	92.6	90.5	98.3	92.9	101.1	87.8	81.6	92.11
	123	127.8	122.1	130.2	128.1	129.4	135.1	134.8	121.3	128.60
	31	47.3	49.9	58.0	56.3	54.8	59.4	47.0	53.9	53.33
IV	61	51.2	61.8	68.0	65.1	72.7	70.9	51.0	66.1	63.35
	92	73.2	91.6	99.8	83.6	91.3	82.3	88.6	71.4	85.23
	123	103.9	109.6	120.7	122.7	123.6	100.1	130.0	129.8	117.55

[a] Planted May 21, 1952; harvested October 11, 1952.

[b] Culture I, no fertilizer; cultures II, III, and IV fertilized at 12 days of age; and cultures II and IV given a second dose at 81 and 91 days of age, respectively.

TABLE 14

Yields of grain and straw

CULTURE NO.	POT NUMBER	WEIGHT OF GRAINS		NO. OF PANICLES	WT. OF PANICLES	WT. OF SUN-DRIED STRAW	GRAIN : STRAW RATIO
		Total	Filled				
		gram	*gram*		*gram*	*gram*	
I	1	17.49	17.20	17	1.03	33.0	
	2	25.63	23.52	19	1.35	46.0	
	3	28.30	24.58	19	1.49	52.2	
	4	23.42	21.48	20	1.17	46.0	
	Average	23.71	21.69	18.75	1.26	44.30	1:1.87
II	1	32.42	30.94	23	1.41	60.8	
	2	22.91	20.95	15	1.53	35.4	
	3	31.93	29.47	21	1.52	54.4	
	4	24.19	22.87	27	0.93	57.9	
	Average	27.86	26.05	21.50	1.34	52.12	1:1.85
III	1	39.40	35.39	28	1.41	58.8	
	2	30.80	28.39	16	1.92	47.9	
	3	49.01	44.67	24	2.04	71.5	
	4	39.22	34.98	26	1.51	63.9	
	Average	39.61	35.86	23.50	1.72	60.53	1:1.53
IV	1	36.73	36.39	25	1.53	62.2	
	2	36.69	36.47	23	1.60	59.3	
	3	23.19	23.07	14	1.66	50.1	
	4	25.61	24.13	16	1.60	49.1	
	Average	30.56	30.02	19.55	1.59	55.18	1:1.81

TABLE 14a

Analysis of variance of total weight of grains

SOURCES OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F-VALUE	
				Computed	Tabular
Treatment	3	543.97	181.32	4.74	3.49 5.95
Error	12	459.49	38.29		
Total	15	1003.46			

LSMD = 9.52

CONTROL OF WEEDS AND DESTRUCTION OF DISEASED ABACÁ PLANTS WITH HERBICIDES [1]

ALFREDO L. ELOJA

WITH FOUR TEXT FIGURES

Single applications of 1.0, 2.0, and 3.0 per cent Amine, Ester, and Fernoxone and of 5.0, 10.0, and 15.0 per cent Shell Weed Killer No. 30 killed the above-ground growths of cogon, but not the rhizomes. Neither did a second nor a third application kill the plants entirely. Loosening the soil on which clipped cogon was growing and then spraying the new growths produced the same results.

Two applications of 0.10, 0.25, and 0.50 per cent Amine, Ester, and Fernoxone reduced the stand of a well-established growth of mutha by 85.10 to 90.35 per cent. Sprayed plants died and their tubers rotted in two to three weeks, but new growths appeared within the third and fourth weeks after spraying.

The successfully controlled weed species and the percentages of minimum concentrations of the active ingredients of Amine and Ester of 2,4,-D needed to effect 100 per cent kill of each species are as follows: *Tithonia diversifolia* Gray, 0.5; *Lantana camara* L., 1.0; *Ageratum conyzoides* L., 0.1; *Synedrella nodiflora* (L.) Gaertn., 0.15; *Elephantopus spicatus* Aubl., 0.4; *Triumfetta bartramia* L., 0.6. The same concentrations of Fernoxone gave 100 per cent kill of the above weeds, except 0.1 and 0.4 per cent which did not kill all *A. conyzoides* and *E. spicatus*.

One spraying of 1.5 or of 2.0 per cent Amine, Ester, and Fernoxone on entire stools or on cut stalks of diseased abacá killed the plants in three to four weeks, but did not prevent the emergence of suckers. A second application of the same concentrations killed the stools completely.

Chemical weeding is already an established practice [2a, 2b] in the United States. In the Philippines, however, this aspect of weed control is still in the experimental stage. As far as the writer is aware, only Capinpin and Ocfemia (1948), Espino (1948), Ocfemia and Javier (1950), and Derico (1951) have made local studies along this line.

This work was conducted from December, 1951, to February, 1953. Since the cost of the material is a limiting factor in the use of chemicals for weed control, the primary object of this study was to determine the minimum concentration of each herbicide necessary to control some common weeds and destroy diseased abacá plants under conditions existing at the time of treatment. The resulting figures may not be true for other times because a number of factors,

[1] Central Experiment Station Contribution No. 1694. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture. Prepared in the Department of Plant Pathology under the direction of Assistant Professor Faustino T. Orillo.

[2a] G. F. WARREN AND K. P. BUCHHOLTZ, *Univ. of Wisconsin Agric. Exper. Sta. Bull. 3* (1948). (Mimeographed).

[2b] H. SWANSON, *Country Gentleman* [6] 122, 58 (1952).

like light, temperature, soil condition, and age and vigor of the plants treated, may influence the effectiveness of herbicides. The efficiences of Amine, Ester, and Fernoxone (sodium salt of 2,4-D) were also compared. The comparison was based on the percentage kill of each herbicide.

MATERIALS AND PROCEDURE

The herbicides [3] used in this study are briefly described below:

1. Du Pont 2,4-D Amine Weed Killer—selective; liquid; contains 49.6 per cent Dimethylamine 2,4-Dichlorophenoxyacetic acid as active ingredient.

2. Hi-Ester 2,4-D Weed Killer—selective; liquid; contains 2,4-Dichlorophenoxyacetic acid, isopropyl ester 50.2 per cent and 2,4-Dichlorophenoxyacetic acid, propylene glycol (C_3H_6O to $C_9H_{13}O_3$) Butyl ether esters 32.6 per cent as active ingredients; total active ingredients, 82.8 per cent.

3. Fernoxone—selective; powder; contains 80.0 per cent sodium salt of 2,4-Dichlorophenoxyacetic acid as active ingredient.

4. Shell Weed Killer No. 30—non-selective; liquid; contains pentachlorophenol as active ingredient.

The herbicides were prepared as aqueous solutions. The concentrations were based on the percentage of active ingredients. At the outset, three concentrations were used: a low range recommended or found by previous investigators, a high range, and an intermediate range. A higher concentration was used when all concentrations failed to obtain 100 per cent kill. On the other hand, when all concentrations gave 100 per cent kill, a lower one was tried to determine the minimum concentration that would effect complete kill.

The experimental areas were selected for homogeneity of one weed species or for the predominance of two species over the others. Areas with young plants were preferred to those with mature plants. Investigations have always shown that young plants are more readily killed by herbicides than mature ones. Each area was divided into several lots [4] and sprayed with each concentration of the four chemicals. Control lots were also provided. The lots were sufficiently spaced to avoid interaction of the different chemicals or concentrations.

The herbicides were applied with a Hudson Clipper Sprayer and a Shelltox Continuous Sprayer at the rate of one liter to every five square meters. The sprayers were washed before and after using

[3] Obtained from the Shell Company, Ltd., and from Macondray and Co., Inc., Manila.

[4] The size of the whole area determined the size of each lot, but no lot exceeded eight square meters or was smaller than four square meters, except in experiments with *Cyperus rotundus* where two square meters were used.

to prevent contamination of chemicals or concentrations. Treatments were made on calm, warm days when no rains were expected and preferably in the morning when the dew had dried from the plants. Rice (1948) found a positive correlation between the amount of 2,4-D absorbed by bean plants and the temperature values during treatment. Weaver, Minarik, and Boyd (1946) reported that rain within 24 hours after application of herbicides reduced their effectiveness. Dew on the leaves of plants dilutes the spray, and wind increases the hazards from drifts.

The lots were labeled with the chemical and concentration used and the date of application. The weeds [5] found on the experimental lots were listed, their vigor and stages of growth noted, and plant counts made when necessary. The soil type of the area, whether light, medium, or heavy, was also noted. The weather data one day before, during, and one week after application of the herbicides were gathered from the Department of Agricultural Engineering (table 1). Much of the influence of weather on the effects of the treatments may be confined to this period. The plants were observed at regular intervals and any change in their appearance was recorded.

Subsequent comparisons of the effectiveness of the three 2,4-D herbicides were made only on the weeds which were successfully controlled. The sublethal dose, *i.e.*, the maximum concentration which did not give 100 per cent kill, and the next higher dose were used for a double purpose: to obtain the percentages kill for comparison of the effectiveness of each chemical and to replicate the previous experiment.

RESULTS AND DISCUSSION

Experiments on cogon (Imperata cylindrica [L.] Beauv.)

Chemical control of cogon with herbicides was tried by Derico (1951). He failed to kill the rhizomes, although the above-ground growths died or were severely injured. New shoots developed within two to four weeks after treatment. The resistance of cogon was reported earlier by Capinpin and Ocfemia (1948) and by Espino (1948).

Experiment 1. This experiment was conducted to determine whether or not repeated applications of higher concentrations would eventually kill the plants to the rhizomes. Cogon, in the prebloming stage, was sprayed with 1.0, 2.0, and 3.0 per cent Amine, Ester, and Fernoxone and with 5.0, 10.0, and 15.0 per cent Shell Weed Killer No. 30. On the second day after treatment, all plants sprayed with 2,4-D showed burnt-like patches on the tips and margins, the areas most wet by the spray. The patches dried up and enlarged. Within two weeks after treatment, the entire leaves dried up and all above-ground growths appeared dead. New leaves appeared within the third and fourth weeks after application of the herbicides. The new growth seemed little or not at all

[5] Identified by Mr. J. V. Pancho, of the Department of Agricultural Botany.

affected by the treatment. Only the tips of the first leaves dried up. Apparently, the tips of these leaves were partly exposed at the time of treatment.

Two days after treatment with Shell Weed Killer No. 30, all leaves wet with the spray dried up. As in the 2,4-D treatments, however, the new leaves that appeared showed little injury. In six to eight weeks, all the treated plants were much the same as the control. A second and a third application of the same concentrations produced the same results even when the third one was made before the new shoots had attained normal growth.

Two weeks after the third application of the herbicides, general wrinkling, cupping, and other malformations of the leaves of broadleaf plants within 10 to 20 meters of the treated lots were noted. The plants that showed injury were the following: achuete (*Bixa orellana* L.), cassava (*Manihot utilissima* Pohl.), calamismis (*Psophocarpus tetragonolobus* [L.] DC.), talinum (*Talinum triangulare* [Jacq.] Willd.), rambutan (*Nephelium lapaceum* L.), malungay (*Moringa oleifera* L.), avocado (*Persea americana* Mill.), papaya (*Carica papaya* L.), mabolo (*Diospyros discolor* Willd.), santol (*Sandoricum koetjape* [Burm. f.] Merr.), eggplant (*Solanum melongena* L.), and gabi (*Colocasia esculentum* [L.] Schott). The leaf petioles of gabi twisted in all directions. Bananas (*Musa sapientum* L.), guanabano (*Anona murricata* L.), and jakfruit (*Artocarpus integrifolia* L.) were not affected. A fourth application on the new cogon growths with 4.0, 6.0, and 8.0 per cent concentrations of the 2,4-D herbicides was not tried because of the danger of further damaging the injured plants mentioned above.

Weaver (1948) stated that it is often difficult to confine spray or dust applications of growth regulators to the intended area. Drifting of spray mists, leaching, and volatilization of the herbicides, particularly of the Ester form, are responsible for the effects of the chemicals on nearby untreated plants.

Experiment 2. Mature cogon was clipped so that a young vigorous growth of new shoots could be obtained. After clipping, each lot was worked with a spading fork to loosen the soil, but not to turn it over. On porous soil, Derico (1951) killed cogon completely with one application of 14.0 per cent Ammate Weed Killer.

The plants were sprayed when the new growths were six to eight inches tall. The same concentrations of herbicides as in experiment 1 were used. Two weeks after treatment, all the leaves were dead, but new growths appeared in three to four weeks.

The results of these two experiments indicate that cogon is not easy to control with chemicals. Even when the above-ground growths are killed, the rhizomes from which new shoots arise remain alive. According to Crafts and Harvey,[6] the inaccessibility

[6] S. Alden Crafts and W. A. Harvey, *California Agric. Ext. Serv. Cir. 157* (1949).

of the growing points of grasses to the chemicals is one reason for their resistance to herbicides.

Experiments on mutha (Cyperus rotundus L.)

Espino (1948) found that mutha was not injured when sprayed with an aqueous solution of 2,4-D at the rate of 9.36 kilograms a hectare. Capinpin and Ocfemia (1948) readily killed this weed with 1000 ppm. of 2,4-D applied at the rate of 1.6 liters to every eight square meters.

Experiment 1. Since the area infested with mutha was only eight square meters, only Ester was used. Three concentrations, 0.10, 0.25, and 0.50 per cent, were sprayed at the rate of 400 cc. to every two-square-meter lot.

In all treatments, yellowing of the leaf tips started two days after spraying. Yellowing progressed downward to the leaf bases and towards the center from the outermost leaves. Death and collapse of the foliage also progressed in the same direction. Eleven days after spraying, all leaves died and fell to the ground. Darkening and decomposition of the tubers took place a little later than the death of the leaves. Although all the leaves died two weeks after treatment, it was not until the third week that all the tubers showed signs of rotting.

The injuries from the higher concentrations appeared earlier or were more severe. The result, however, was the same—the leaves died and the tubers rotted. No new growths were observed in this area up to the end of the study in February, 1953.

Experiment 2. A wider area with a thick, solid growth of mutha was located in December, 1952. A second experiment similar to the first was conducted on this area, using the same concentrations and rate of application of all the three 2,4-D herbicides. All plants treated were killed within two weeks after spraying, but new growths appeared in three to four weeks. Apparently, the herbicides, at the rate of application used, were not translocated from tuber to tuber. Only the tuber immediately below the plant killed by the spray rotted. Other tubers connected to the dead one by runners were not affected by the treatment. They continued to send up new shoots to the surface. Plant counts were made on the new growths on each lot, and a second spraying was done four weeks after the first. The second application did not eradicate the weeds on each lot; there was, however, a reduction in stand of 85.10 to 90.35 per cent of the original (table 2).

Burgis[7] did not completely control *C. rotundus* with 2 to 5 pounds 2,4-D to the acre, applied three times at monthly intervals. He attributed the appearance of new growths to the number of dormant tubers in the soil when this weed is well established in an area.

[7] D. S. Burgis, *Univ. of Fla. Exper. Sta. Cir. S-38* (1951).

Experiments on wild sunflower (Tithonia diversifolia Gray)

Experiment 1. Wild sunflower, in the early flowering stage, was sprayed with 0.5, 1.0, and 1.5 per cent of the 2,4-D herbicides and with 3.0, 4.0, and 5.0 per cent of Shell Weed Killer No. 30. In all the 2,4-D treated lots, the leaves of the plants wilted and drooped slightly after 24 hours. The petioles, terminal shoots, and flower stalks bent and twisted in all directions. Later, the leaves thickened and became malformed and brittle. The petals wilted and the flow-

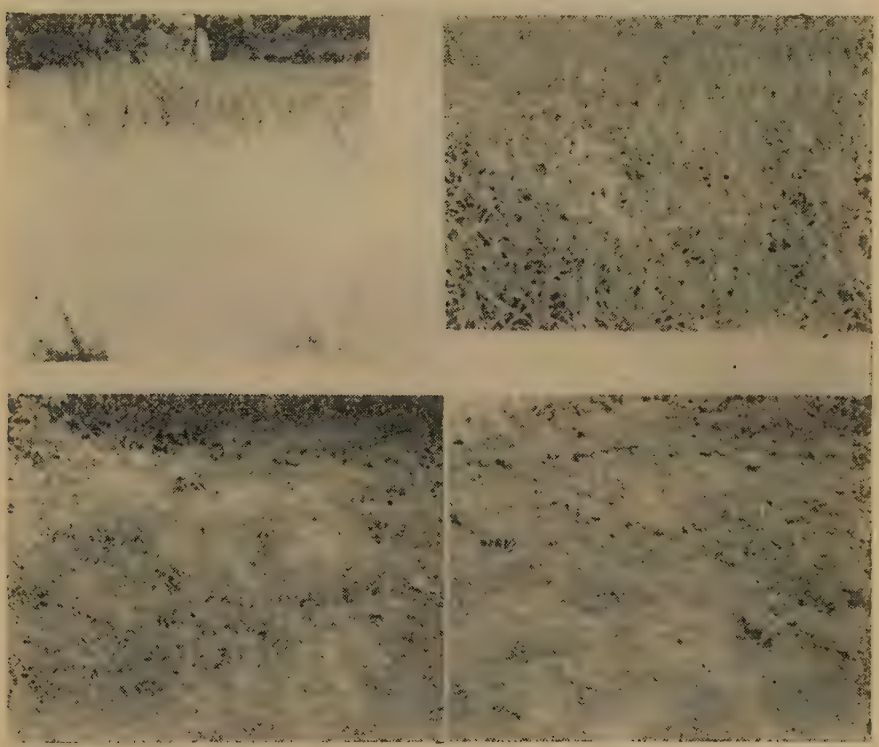

Fig. 1.—Upper panel, left, cogon two weeks after spraying with 3.0 per cent 2,4-D Ester. Note the light color of dead leaves in contrast with the dark-green, upright leaves of unsprayed plants in the background. Right, mutha control lot. Lower panel, left, mutha experimental lot two weeks after spraying with 0.5 per cent 2,4-D Ester; right, the same lot three weeks after the second spraying with the same concentration of the same herbicide. Note the new shoots that have appeared.

ers died prematurely. Yellowing and drying of the leaves beginning at the tips and margins started with the lower older ones and progressed until all the leaves were shed. In six weeks, defoliation was complete (fig. 1) and the roots, when dug up, were found to be dead.

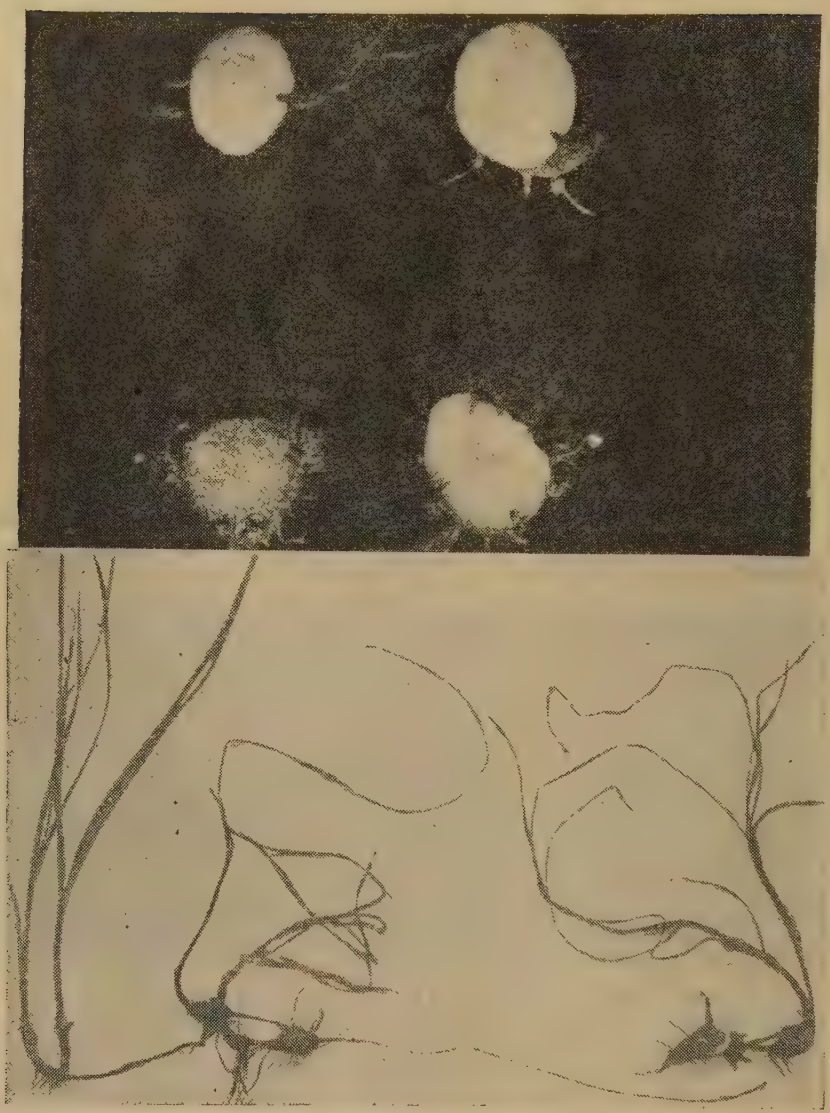

Fig. 2.—Upper panel, cross-sections of mutha tubers. The two above were taken from control plants. The ones below were taken from plants killed by 0.5 per cent 2,4-D Ester. Note the darkened and decomposing tissues of the latter. Lower panel, mutha plants at left showing new shoots from runners connected to plants killed by a previous spray of 0.5 per cent 2,4-D Ester. Note another small shoot arising from the tuber very close to the two dead plants at right.

The effect of Shell Weed Killer No. 30 was distinct from those of the 2,4-D herbicides. With all concentrations, severe wilting occurred in about thirty minutes after spraying. Drying of the wilted leaves progressed rapidly, and in five days no more green leaves remained. In some instances, particularly with the higher concentrations, the young stems appeared scalded and bent. The plants reacted to the sudden death of the tops by profuse production of sprouts. When the sprouts had three to four leaves and the produc-

Fig. 3.—Upper left, unsprayed wild sunflower at the Los Baños Catholic Cemetery; upper right, two weeks after spraying with 1.5 per cent 2,4-D Ester. Lower left, six weeks after, showing complete defoliation and death; lower right, *Lantana camara* L. two weeks after spraying with 10 per cent 2,4-D Ester, showing severe wilting and partial defoliation. After four weeks the treated plants were completely killed.

tion of new ones had apparently ceased, a second application of the same concentrations of Shell Weed Killer No. 30 was made. The new growths were killed in three days, but other sprouts appeared farther down the stems. A third application killed these new shoots. When the roots were dug up, most of them were found to be dead.

Torrey and Thimann (1949) concluded that repeated applications of herbicides on new growths of *Dichrostachys nutans* Benth. appearing after each treatment finally exhaust the starch reserves of the plant and kill the plant.

Experiment 2. Since all treated plants were killed in the first experiment, a second one was made, using lower concentrations of 0.10, 0.25, and 0.50 per cent of the 2,4-D herbicides. Shell Weed Killer No. 30 could not be included because the material had been used up in the previous experiments. The 0.50 per cent concentrations killed all the treated plants to the roots in three to four weeks. Some plants survived in the 0.10 and 0.25 per cent treatments (table 3). Surviving plants, though severely injured, had a few remaining green leaves after four weeks. Numerous small shoots appeared at the terminal portion of the stems of these plants. A second application of the herbicides killed them completely.

Experiments on other broad-leaf plants

Lantana camara L. Lantana was sprayed with 0.5, 1.0, and 1.5 per cent Amine, Ester, and Fernoxone. As shown in table 4, 1.0 and 1.5 per cent concentrations gave 100 per cent kill (fig. 3). The 0.5 per cent treatments gave 90.38 to 95.83 per cent kill. Derico (1951) killed lantana at the flowering stage with single applications of 1.0, 1.5, and 2.5 per cent Esteron 44 and Fernoxone. A 1000 ppm. concentration (0.1 per cent) of 2,4-D was reported by Capinpin and Ocfemia (1948) to kill lantana seedlings. These previous reports and the results of this experiment again illustrate that younger plants are more readily killed than mature ones. The plants treated in the present experiment were in the preblooming stage.

Ageratum conyzoides L. and Synedrella nodiflora (L.) Gaertn. Amine, Ester, and Fernoxone in concentrations of 0.05, 0.10, and 0.15 per cent were sprayed on *A. conyzoides* L. and *S. nodiflora* (L.) Gaertn. which grew together in one experimental area. The 0.10 per cent concentrations, except that of Fernoxone, and the 0.15 per cent concentrations killed all *A. conyzoides* (table 5). Some plants were not killed by the 0.95 per cent concentrations. With *S. nodiflora*, both 0.05 and 0.10 per cent concentrations failed to give 100 per cent kill. Only the 0.15 per cent treatments killed all sprayed plants (fig. 4).

The more fibrous nature and more mature stage of growth of *S. nodiflora* may account for the higher concentration necessary to effect 100 per cent kill. *A. conyzoides* is more succulent than *S. nodiflora*. Moreover, at the time of treatment, plants of the former species were very young.

The results of this experiment agree closely with Capinpin and Ocfemia's report (1948). These workers killed both species with 1000 ppm. (0.1 per cent) 2,4-D.

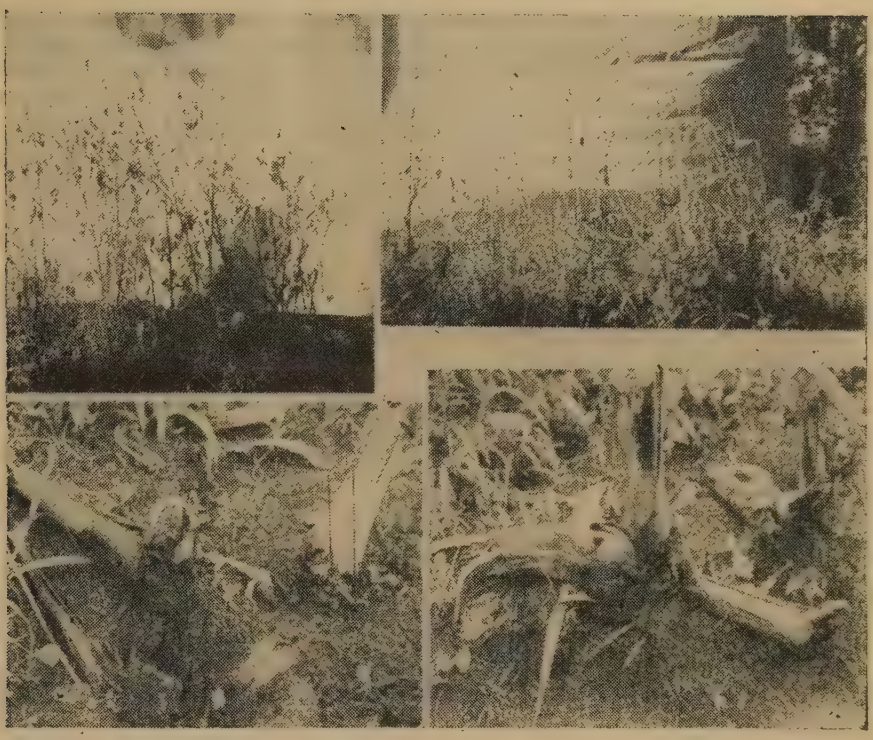

Fig. 4.—Upper panel, left, *Triumfetta bartramia* and *Elephantopus spicatus* three weeks after spraying with 0.6 per cent 2,4-D Ester. Note the unaffected leaves of *Calopogonium muconoides* below. Right, mixed growth of *Synedrella nodiflora* and *Ageratum conyzoides* four weeks after spraying with 0.15 per cent 2,4-D Ester. The small growth of *A. conyzoides* killed much earlier has been overgrown by *Paspalum conjugatum*, which was not affected by the treatment. Lower panel, left, bunchy-topped abacá plants four weeks after treatment with 2.0 per cent 2,4-D Ester on the cut stalks. Note that the two suckers (arrows) are beginning to appear. Lower right, two plants which apparently are more mature than the rest. They are not ringed at the bases probably because they were no longer in the growing stage when treatment was made.

Elephantopus spicatus Aubl. and Triumfetta bartramia L. A mixed growth of *E. spicatus* and *T. bartramia* was sprayed with 0.1, 0.2, and 0.4 per cent concentrations of the 2,4-D herbicides. On *E. spicatus*, 0.4 per cent concentrations of the Amine and Ester gave 100 per cent kill (table 6). For all three herbicides, the average kill was 72.88 per cent at 0.2 per cent concentrations and 47.67 per cent at 0.1 per cent concentrations. Capinpin and Ocfemia (1948) obtained 100 per cent kill of this weed with 1000 ppm. (0.1 per cent) 2,4-D. Weaver and DeRose (1946) observed that plants kept in darkness (where no photosynthesis could take place) after treatment with 2,4-D showed little or no injury. They concluded

that the translocation of the material in the tissues of the plants follows the movement of synthesized carbohydrates during photosynthesis. It is probable that the plants in this experiment, which were shaded most of the day, were not actively photosynthesizing; hence, a higher concentration of the herbicides than that previously reported was needed to kill them.

None of the treatments gave 100 per cent kill on *T. bartramia* (table 6). The younger plants were killed by all concentrations used, but the older plants remained alive and showed signs of recovery by the end of the fourth week. The surviving plants were sprayed a second time while a 0.6 per cent concentration was sprayed on another area. All the plants were killed in both treatments (fig. 4, left).

Minor weeds. The minor weeds found in the experimental lots were *Paspalum conjugatum* Berg., *Mimosa pudica* L., *Calopogonium muconoides* Desv., *Asystasia gangetica* (L.) Anders., and *Cyathula prostrata* (L.) Bl. These weeds were either unharmed or only slightly injured by the different herbicide treatments. It does not necessarily mean, however, that these species are resistant. The sprays were not trained directly on them. Any injury caused by the treatments may have only been due to drifts and droplets of spray from the treated plants.

The comparative efficiencies of the three 2,4-D herbicides are show in table 7. The figures could not be treated statistically because of the number of variables beyond the worker's control. Nevertheless, it may be safe to conclude that Ester is the best of the three. With all the weeds studied, Ester consistently gave higher percentages of kill than either Amine or Fernoxone. Thimann (1948) found that Weedon, the Ester form, was better than either the Amine or the Sodium salt form. He reported that the oiliness of this form makes it adhere to the leaf surface so that instead of running off, it hangs as a sticky drop at the tip of the leaf. Since it stays for a longer period on the leaf surface, more of it is absorbed by the plant.

Experiments on diseased abacá plants

Control of diseased abacá plants by digging and burning them is very tedious and expensive. Reinking [8] reported a cheap method using 2,4-D herbicides. Derico (1951) killed mosaicked abacá plants by applying 2.0 per cent 2,4-Dow Weed Killer on the cut surfaces of the stalks. Jeater, Cann, and Eastwood (1951) used 2,4-D to destroy bananas.

Experiment 1. On account of the limited number of bunchy-topped abacá plants, only two concentrations, 1.5 and 2.0 per cent, of the three 2,4-D herbicides were used. The plants were cut 15 to

[8] Otto Reinking, "Second Progress Report on Abacá Mosaic Disease Control Campaign," 1951. (Mimeographed).

20 centimeters from the ground. When the sap had dried, the chemicals were sprayed on the cut surfaces and all over the stumps. Only one-half liter was sprayed on every two hills averaging four plants each, or about sixty cc. to every stalk.

Twenty-four hours after treatment, the central cylinders had grown from the cut pseudostems to a length of about one to three inches. In two to five days, the white or pale-green cylinders became dark brown and water-soaked. Then they died and rotted. Another injury not reported by Derico (1951) was ringing of the pseudostems just above the corm (fig. 4). The fibers gave way, resulting in cracks that ringed or girdled the stalks. When this happened, the abacá stumps fell wherever they had been previously inclined. Very often the lower portion of the central cylinder forced itself through the crack at the bend of the stalk. This type of injury may have been due to the abnormally excessive growth of the plants induced by the herbicides. Some plants which were more mature did not exhibit this injury apparently because they were no longer actively growing.

Rotting of the stalks started from the central cylinders and from the cracks. These parts were completely rotted in three to four weeks, although the outer parts still remained green.

Experiment 2. Bunchy-topped abacá plants are small and may be easily sprayed without cutting down the stalks. More material will be needed, but the additional cost will be more than offset by the reduction in labor expense, the cutting process being eliminated. A second experiment was made to determine the effect of spraying upon the entire stools. Only 2.0 per cent concentration was used. There were 18 plants in the two hills sprayed. One liter of solution was used on these two hills. The first effect, which was noticeable three days after treatment, was the darkening of the bases of the petioles where the material had run off from the leaves and accumulated. Later, the leaves turned yellow and the youngest unfurled leaf darkened and rotted. Although the plants were obviously dead, they remained upright four weeks after treatment. They did not fall until five to six weeks later when the outer leaf sheaths also rotted.

Derico (1951) reported that no suckers appeared in abacá stools treated with 2.0 per cent 2,4-Dow Weed Killer. Jeater and his associates (1951) observed that 1.5 to 28 cc. of 3⅛ to 50 per cent 2,4-D injected into or sprayed on individual plants in a hill did not prevent the emergence of suckers. The new growths were killed by a second application of the herbicides. In the present study, suckers (fig. 4) appeared in all treatments except in the hills where 2.0 per cent Amine was applied on the cut stalks. Some suckers which emerged soon after treatment had dark-brown, water-soaked tips which became the starting points of rotting. The rotting continued downward until the suckers died. Suckers that emerged two weeks after treatment appeared unaffected. They were killed by a second spray of the herbicides even without cutting.

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TABLE 1

Conditions of the experiments which may have influenced the results

EXPERIMENT ON	SOIL TYPE OF AREA	DATE OF TREATMENT	WEATHER DATA			REMARKS
			Temp.[b]	Relative humidity [b]	Total precipitation	
			°C.	*per cent*	*mm.*	
Cogon (1)[a]	medium	3/1/52	26.6	75.5	14.3[c]	Plants mature and well established.
Cogon (2)	"	8/2/52	24.9	92.9	196.2	New shoots after clipping, 6 to 8 inches tall.
Mutha (1)	light	5/24/52	28.1	79.1	28.2[c]	Area partly shaded; sparse new growth of plants.
Mutha (2)	heavy	12/5/52	25.3	84.0	18.3[c]	Area in the open; plants well established.
Wild sunflower (1)	medium	1/12/52	25.6	79.5	10.1	Plants just beginning to flower.
Wild sunflower (2)	"	11/21/52	26.3	84.3	44.0[c]	New growths from old stumps.
Lantana camara	heavy	4/15/52	28.6	72.8	3.7	Area exposed in the morning, shaded in the afternoon.
Ageratum conyzoides	medium	8/15/52	27.4	83.8	54.5	Area shaded most of the day; *A. conyzoides* just past the seedling stage; *S. nodiflora* mature.
Synedrella nodiflora	"	"	"	"	"	
Elephantopus spicatus	"	10/4/52	27.0	83.1	23.1	Area shaded most of the day; *E. spicatus* in preblooming stage; *T. bartramia* mixed growth of young and mature plants.
Triumfetta bartramia	"	"	"	"	"	
Abacá (1)	"	11/13/52	26.7	82.1	9.5	Area shaded; plants markedly diseased.
Abacá (2)	"	1/17/53	25.2	76.6	9.9	" " " " "

[a] Figure represents the experiment number.
[b] Mean taken for nine days; one day before treatment, day of treatment, and seven days after treatment.
[c] It rained 24 hours after application of herbicides.

TABLE 2

Reduction in stand of mutha after two applications of different concentrations of Amine, Ester, and Fernoxone at four weeks' interval

HERBICIDE	CONCENTRATION	ORIGINAL COUNT	AFTER FIRST SPRAY		AFTER SECOND SPRAY	
			Plant count	Percentage of reduction [a]	Plant count	Percentage of reduction [a]
	per cent					
Amine	0.10	1,940	426	78.04	289	85.10
	0.25	1,786	321	82.03	232	87.01
	0.50	1,894	326	82.79	202	89.33
Ester	0.10	1,668	319	80.88	223	86.63
	0.25	1,409	225	84.03	136	90.35
	0.50	1,787	290	83.77	179	89.98
Fernoxone	0.10	1,076	227	78.90	139	87.08
	0.25	1,253	238	81.01	151	87.95
	0.50	1,092	191	82.51	154	85.90

[a] Based on the original count.

TABLE 3

Percentages of kill of different concentrations of Amine, Ester, and Fernoxone sprayed on wild sunflower

HERBICIDE	CONCENTRATION	ORIGINAL COUNT	FINAL COUNT [a]	PERCENTAGE KILLED
	per cent			
Amine	0.10	12	7	41.67
	0.25	18	7	61.11
	0.50	16	0	100.00
Ester	0.10	16	8	50.00
	0.25	13	3	76.92
	0.50	18	0	100.00
Fernoxone	0.10	17	10	41.18
	0.25	21	6	71.43
	0.50	17	0	100.00

[a] Four weeks after treatment.

TABLE 4

Percentages of kill of different concentrations of Amine, Ester, and Fernoxone sprayed on Lantana camara

HERBICIDE	CONCENTRATION	ORIGINAL COUNT	FINAL COUNT [a]	PERCENTAGE KILLED
	per cent			
Amine	0.5	52	5	90.38
	1.0	48	0	100.00
	1.5	56	0	100.00
Ester	0.5	48	2	95.83
	1.0	56	0	100.00
	1.5	50	0	100.00
Fernoxone	0.5	55	5	90.91
	1.0	54	0	100.00
	1.5	51	0	100.00

[a] Four and a half weeks after treatment.

TABLE 5

Percentages of kill of different concentrations of Amine, Ester, and Fernoxone sprayed on Ageratum conyzoides and Synedrella nodiflora

HERBICIDE	CONCENTRATION	AGERATUM CONYZOIDES			SYNEDRELLA NODIFLORA		
		Original count	Final count	Percentage killed	Original count	Final count [a]	Percentage killed
	per cent						
Amine	0.05	114	44	61.40	39	23	41.03
	0.10	126	0	100.00	50	14	72.00
	0.15	108	0	100.00	29	0	100.00
Ester	0.05	117	42	64.10	46	22	52.17
	0.10	102	0	100.00	38	8	78.95
	0.15	120	0	100.00	44	0	100.00
Fernoxone	0.05	104	50	51.92	36	19	47.22
	0.10	112	5	95.54	48	15	68.75
	0.15	119	0	100.00	40	0	100.00

[a] Four weeks after treatment.

TABLE 6

Percentages of kill of different concentrations of Amine, Ester, and Fernoxone sprayed on Elephantopus spicatus and Triumfetta bartramia

HERBICIDE	CONCENTRATION	ELEPHANTOPUS SPICATUS			TRIUMFETTA BARTRAMIA		
		Original count	Final count [a]	Percentage killed	Original count [a]	Final count [a]	Percentage killed
	per cent						
Amine	0.1	68	35	48.53	24	21	12.50
	0.2	64	19	70.31	18	8	55.56
	0.4	65	0	100.00	23	6	73.91
	0.6	67	0	100.00	20	0	100.00
Ester	0.1	62	30	51.61	20	17	15.00
	0.2	65	14	78.46	19	8	57.89
	0.4	71	0	100.00	24	4	83.33
	0.6	68	0	100.00	22	0	100.00
Fernoxone	0.1	63	36	42.86	17	17	0
	0.2	73	22	69.86	23	15	34.78
	0.4	68	2	97.06	28	8	71.43
	0.6	65	0	100.00	25	0	100.00

[a] Four weeks after treatment.

TABLE 7

Percentages of kill of Amine, Ester, and Fernoxone

PLANT TREATED	CONCENTRATION	AMINE			ESTER			FERNOXONE		
		Original count	Final count	Percentage killed	Original count	Final count	Percentage killed	Original count	Final count	Percentage killed
	per cent									
T. diversifolia	0.25	26	9	65.38	23	6	73.91	18	6	66.67
L. camara	0.50	46	5	89.13	54	4	92.59	48	6	87.50
A. conyzoides	0.05	128	50	60.94	132	34	74.24	152	63	58.55
S. nodiflora	0.10	54	17	68.52	48	14	70.83	43	14	67.44
E. spicatus	0.20	83	23	72.29	65	14	78.46	64	18	71.88
T. bartramia	0.40	26	8	69.23	18	5	72.22	19	6	68.42
Mean				70.91			77.04			70.68

MARKETING COCONUTS AND COPRA IN THE UPLAND TOWNS OF CAVITE [1]

N. B. Tablante and Marcos M. Nuestro [2]

WITH THREE TEXT FIGURES

Coconuts were sold either by contract, by outright sale of the assembled husked nuts, or as copra. The different market outlets were copra processors, local buyers of nuts, public markets, the Franklin Baker Company, Manila markets, and local copra buyers. Coconut producers usually gathered and sold their coconuts from three to four times a year. The price of coconuts was generally high in November, December, and January so that more farmers harvested and sold their nuts during these months than any other period.

Copra was prepared for the market by the sun-drying and *tapahan* methods. It was either shipped directly to Manila exporters by the copra producers themselves or sold to local copra merchants, who paid practically the same amount for 100 kilos of copra regardless of grade. The higher the prices and the more favorable the relationship between copra and coconut prices, the larger the quantities of copra sold. The quality of copra produced in Cavite was rather low. An average of 238 kilograms of copra, worth ₱60.69, was produced from 1,000 coconuts. The farmer only received an average of ₱46.87. There was a total market spread of ₱13.82 for transporting the nuts from the plantation to the *tapahan*, making the nuts into copra, loading and unloading, and paying the internal revenue tax and miscellaneous costs.

Coconut is one of the major agricultural products of Cavite. To understand the marketing of coconuts and copra and to determine the problems connected with the process, the present study was made in the upland towns of Cavite from January to December, 1952.

MATERIALS AND METHODS

A survey was made in the principal coconut-producing towns of Indang, Silang, Alfonso, Mendez, and Amadeo in the province of Cavite. Two to five coconut producers operating a minimum of two hectares each were selected from each of the 28 barrios within seven kilometers of the towns. A total of 126 producers was visited every two or three months, and the data collected were recorded in mimeographed questionnaires previously prepared in the Department of Agricultural Economics, Merchants, processors of products, transportation men, government officials, and employees of some companies were asked about the buying and selling of coconuts and coconut

[1] Central Experiment Station Contribution No. 1695. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture. Prepared in the Department of Agricultural Economics under the direction of the senior author.

[2] The authors wish to express their appreciation to the many farmers who contributed information and to Dr. C. A. Bratton, visiting professor of agricultural economics, for his valuable suggestions.

products, the costs involved, and other pertinent data. Local consumers and some coconut producers with coconut plantations of less than two hectares each were also interviewed about important problems of marketing.

DISCUSSION OF RESULTS

Description of the farms surveyed. Table 1 shows the distribution of the farms according to locality, area, production, and receipts from sales.

In a tenant-operated farm, the tenant is expected to harvest, pile, husk, and transport the nuts from the plantation to the market or to take out the expenses for these operations from his share of the crop. Two-thirds of the harvest goes to the landlord and one-third to the tenant. While it is the responsibility of the tenant to clean, fence, replant, and take care of the plantation, the landlord supplies him with the necessary materials and advances him some money for which no interest is generally charged and which can be repaid after the crop is marketed. When catch crops are planted, the landlord gets an equal share of the produce if he furnished the work animal, equipment, and planting materials; if he did not provide any of these things, he receives no share, although oftentimes the tenant feels obligated to give him a little of the harvest. Some landlords discuss with their tenants when and how to market the coconuts; others leave the marketing of the products entirely to the tenant.

Preparation of coconuts for the market. The nuts are picked from the tree, usually with a large scythe attached to a light, adjustable, bamboo pole, and piled in some convenient place in the plantation. The number of nuts that can be harvested by a man in a day using this method depends upon the height of the tree and the number of fruits that are ready for picking.

The husks of the coconuts need to be removed before the products are transported over land routes. They are removed with the pointed end of a plowshare mounted on a wooden tripod (fig. 1). This husker is anchored firmly on level ground. The laborer stands beside and in line with the share, with one foot slightly to the rear. Holding the nut firmly with both hands, he strikes it against the share with a downward-forward push.

Methods used in selling coconuts. Coconuts were sold by the farmers either by contract or by outright sale of the assembled husked nuts or were first processed into copra.

When nuts are sold on contract basis, the buyer buys the coconuts of a plantation at a stipulated price and bears all the expenses of preparing the products for the market, including transportation and labor costs.

In the second method, the buyer pays for the husked nuts already assembled at a place readily accessible to transportation. The farmer bears the expenses of preparing the nuts for market, which include those for gathering, piling, husking, and hauling the nuts

Fig. 1.—Laborers husking coconuts on a plowshare mounted on a wooden tripod.

from the plantation to the roadside or some other convenient place. The buyer bears all the marketing expenses from the time he buys the husked nuts.

Sometimes the coconuts are processed into copra either by the farmers themselves or by some established copra processors. In either case, the farmer bears the responsibility of preparing the nuts for the market before they are split for drying into copra.

Table 2 shows the different market outlets used by the 126 coconut farmers and the average quantity of nuts absorbed by each outlet. A total of 2,483,399 nuts was sent to the various outlets, with the established copra makers buying the largest number of nuts.

Variation in quantity and price of coconuts. Coconut producers usually gathered and sold their coconuts from three to four times a year. Sometimes good prices or the need for cash tended to disrupt this regular sequence of harvesting and marketing.

As may be seen in table 3, the price of coconuts was higher in November, December, and January. On the whole, therefore, the farmers harvested and sold more nuts during these months than in any other period. From February to September, inclusive, the price of coconuts did not fluctuate very much. The price of coconuts started to rise in October and began to drop in January.

The total number of nuts harvested varied during the year. Not all of the nuts harvested were sold, however; some were processed into copra by the farmers themselves.

Preparation of copra for the market. The coconut producers employed the sun-drying and *tapahan* methods of preparing copra for the market. Sun-drying is probably the oldest method of preparing copra. In this method, the unhusked nuts are cut into halves with an ax. The copra producers are thus able to save on the cost of husking, but it is not known if this saving is offset by the labor cost for the longer period of drying. The halved nuts are left in the sun to dry with the meat exposed. After two or three days' exposure, the coconut meat is easily scooped out of the shell with the blade of a bolo. In this region, it usually takes an average of six to eight days of bright sun to dry the copra very well. Sun-dried copra is claimed by the buyers to be the best in quality because it is clean and free from soot.

The *tapahan* or artificial-drying method (figs. 2 and 3) is a much quicker way of drying copra. The husked coconuts are split into halves and then arranged upside down on the *tapahan* one over the other. After four to six hours of continuous heating, the meat is removed from the shell, sliced into small pieces, and again placed on the drier to reduce the moisture content further. Smoked or *tapahan* copra is of poorer quality than sun-dried copra.

Methods of selling copra. Copra was either shipped by the producers directly to Manila exporters or was sold to middlemen (local copra merchants) who in turn sold it to buyers in Manila. Only two of the 43 farmers making their own copra used the first method. Trucks transported the product to Manila. The farmers who had previously received cash advances from the copra merchants were pledged to sell their product to these merchants, who ordinarily dictated the price. Generally the merchants paid relatively lower prices to the growers.

The price paid by the copra buyers to the producers, as reported by the buyers, was based on the "Buen Corriente" grade. This means that only one price was set regardless of the quality of the product sold so that those producers who had better grades of copra received practically the same amount as those who had poorer grades. Hence, the copra producers had no incentive to improve the quality of their product. The copra merchants, however, were paid by the buyers in Manila on "Resecada" basis, which means that after the copra had been analyzed for moisture content and the grades had

Fig. 2.—Transferring halved nuts to the *tapahan* for drying.

been improved, the price ordinarily paid was that for the "Resecada" grade.

The grades of copra as reported by the Manila exporters were Resecada (R), containing no moisture; Semi-Resecada (SR), with 5 per cent moisture; Buen Corriente Mejorado (BCM), with 7.5 per cent; Buen Corriente (BC), with 10 per cent; Corriente Mejorado (CM), with 15 per cent; and Corriente (C), with 20 per cent. For conversion into the Resecada basis, the corresponding percentage of moisture of the other grade was deducted from the weight of the copra being sold. For example, if 100 kilos of Buen Corriente were delivered, 10 kilos would be "lost" and the prevailing price for the Resecada grade would be paid for only 90 kilograms of the product.

The standard grades of copra prescribed by the newly created Division of Standards of the Bureau of Commerce in Administrative Order No. 2 are Resecada Bodega (RB)—6 per cent moisture, Resecada (R)—7.6 per cent, Semi-Resecada (SR)—9 per cent, Buen Corriente Mejorado (BCM)—12 per cent, Buen Corriente (BC)—15 per cent, Corriente Mejorado (CM)—20 per cent, and Corriente

Fig. 3.—A *tapahan* in a plantation in Indang, Cavite.

(C)—22 per cent. These standard grades differ slightly from the grades reported by the Manila exporters.

Variation in price and quantity of copra marketed. Table 3 shows the variation in prices received by farmers for every hundred kilograms of copra sold on the Buen Corriente basis, as well as the monthly variation in quantity marketed. The general tendency was to market larger quantities of coconuts when prices were high and copra prices were relatively unfavorable. In general, whenever the price of 100 kilos of copra was one-half over the price of 1,000 nuts, it was favorable for the farmers to make their nuts into copra. This condition was observed in January, February, March, April, October, November, and December.

In April, although the price was not very high, the second highest quantity of copra was sold during the year. This may be explained by the fact that many farmers needed cash for their respective town fiestas in May. They were thus forced to sell a large quantity of copra even if the price was comparatively low.

The monthly variation in quantity of the different grades of copra sold in Manila and in average price received for every hundred kilograms on the Resecada basis (table 4) was taken from the records of four middlemen or local copra buyers who shipped the product to Manila. The price of copra was high from October to March. The highest price was realized in November, for Buen Corriente and Resecada, and the lowest was in July, also for Buen Corriente and Resecada. It may be noted that the quality of copra purchased from the farmers in the Cavite area was rather poor.

Cost of marketing copra produced from 1,000 coconuts. An average of 238 kilograms of copra was produced from 1,000 coconuts by the 43 growers selling copra. At the average price of ₱28.33 a hundred kilograms of Resecada grade, this quantity produced would have a value of ₱60.69. The farmers, however, only received ₱46.87, which was 77.2 per cent of the average price they should have received. There was a total marketing spread, therefore, of ₱13.82, or 22.8 per cent (table 5).

The total market differential in marketing the 238 kilograms of copra was made up of such items of cost as transporting the nuts from the plantation to the *tapahan,* making the nuts into copra, loading and unloading the product, and paying the internal revenue tax for selling copra and the middlemen's margin. If all transportation and loading and unloading expenses were added together, the sum would make up the greatest proportion of the total marketing spread. The cost of transporting the copra to Manila was computed on the basis of ₱1.50 for every hundred kilograms.

RECOMMENDATIONS

Considering the volume of coconuts and copra sold in the upland towns of Cavite, the producers might do the following:

1. Organize a cooperative marketing association.
2. Use modern improved driers.
3. Study methods which will use labor more efficiently in the harvesting and marketing of coconuts and copra.

The government might help improve the marketing system by doing the following:

1. Provide market news information.
2. Enforce the grading and inspection system prescribed by law.

3. Launch an educational program to encourage the purchase of coconuts and copra on the basis of grade as prescribed by law.

4. Provide credit facilities for small farmers who are now at the mercy of middlemen.

5. Improve the roads so as to facilitate the transportation of products to the market.

Interested persons might investigate the possibilities of putting up an industrial coconut plant in the area.

TABLE 1

Location, area, number of bearing trees, quantity of nuts and copra sold, and receipts from marketing of 126 farms in Cavite in 1952

ITEM	OWNER-OPERATED		TENANT-OPERATED		ALL FARMS	
	Total	Average	Total	Average	Total	Average
Number of farms surveyed in:						
Indang	16	—	32	—	48	—
Silang	12	—	17	—	29	—
Alfonso	14	—	13	—	27	—
Mendez	7	—	5	—	12	—
Amadeo	8	—	2	—	10	—
Total	57	11.4	69	13.8	126	25.2
Area of coconut plantations (hectares)	186	3.3	390	5.6	576	4.5
Number of coconut plantations	19,034	333.9	38,024	551.1	57,058	452.8
Number of nuts gathered and sold	814,038	14,281.3	1,669,361	24,193.6	2,483,399	19,709.5
Quantity of copra marketed (kilograms)	89,104	1,563.2	118,125	1,711.9	207,229	1,644.6
Average price received for 1000 nuts (pesos)	—	47.58	—	46.16	—	46.87
Receipts from sale of nuts (pesos)	21,131.71	370.23	53,926.79	781.54	75,058.50	595.70
Average price received for 100 kilograms of copra (pesos)	—	22.50	—	22.27	—	22.38
Receipts from sale of copra (pesos)	20,048.40	351.72	26,306.44	382.12	46,354.84	367.89
Receipts from copra and nuts (pesos)	41,180.11	722.46	80,233.23	1,162.80	121,413.34	965.59

TABLE 2

Market outlets used by 126 farmers in Cavite in 1952

MARKET OUTLET	NUMBER OF FARMERS	PERCENTAGE OF TOTAL	TOTAL QUANTITY SOLD TO EACH OUTLET
Copra makers	47	37.3	928,554
Farmers doing their own copra making	43	34.1	871,011
Local buyers	13	10.4	256,194
Public markets	10	7.9	232,483
Franklin Baker Company	10	7.9	157,509
Other outlets	3	2.4	37,648
Total	126	100.0 [a]	2,483,399

[a] Rounded figure.

TABLE 3

Variation in quantity and prices of coconuts and copra marketed by 126 farms in Cavite in 1952

MONTH	NUMBER OF FARMERS REPORTING		TOTAL NUMBER OF NUTS HARVESTED	NUMBER OF NUTS SOLD	QUANTITY OF COPRA MARKETED	AVERAGE PRICE RECEIVED	
	Coconuts	Copra				For 1,000 nuts	For 100 kilos of copra BC
					kilograms	*pesos*	*pesos*
January	37	12	235,797	137,907	23,170	53.47	26.00
February	21	14	237,600	159,520	18,944	44.82	23.70
March	27	10	184,520	120,715	14,927	42.30	22.50
April	29	14	243,580	112,850	31,007	43.31	19.90
May	20	6	116,788	86,628	7,145	43.83	18.50
June	22	1	143,755	141,455	568	40.28	18.10
July	21	6	131,108	94,010	8,794	41.52	17.25
August	29	7	174,798	140,400	7,966	43.33	18.35
September	24	1	122,650	112,665	2,366	43.89	18.30
October	21	3	131,845	102,176	7,056	49.38	24.50
November	30	25	465,341	208,540	62,475	57.38	31.50
December	41	11	295,617	195,522	22,811	58.89	30.00
Monthly Average			206,949	134,365.6	17,269.1	46.87	22.38

TABLE 4

Variation in quantity, price, and grade of copra handled and marketed by four middlemen from January to December, 1952

MONTH	ALL GRADES	QUANTITY SOLD IN KILOGRAMS					AVERAGE PRICE FOR 100 KILOS RESECADA BASIS
		Classification or grade					
		R	SR	BCM	BC	CM	
							pesos
January	215,148	40,331	25,897	28,243	102,922	17,755	31.75
February	158,483	15,265	29,467	22,946	81,723	9,082	29.50
March	159,436	28,327	48,055	18,561	63,252	1,241	27.00
April	127,678	19,171	23,124	26,474	56,210	2,699	24.50
May	105,911	11,849	21,123	20,426	47,447	5,066	24.00
June	50,664	3,270	10,783	3,148	27,910	5,553	23.50
July	62,882	776	5,546	5,920	41,862	8,778	21.80
August	74,174	2,316	16,975	14,734	33,942	6,207	23.80
September	78,276	—	16,698	13,277	47,274	1,027	26.50
October	69,576	3,242	11,305	11,545	40,731	2,753	32.50
November	219,508	3,431	41,361	42,998	110,587	21,131	38.20
December	199,289	9,391	41,711	68,854	65,524	13,809	37.00
Total	1,521,025	137,369	292,045	277,126	719,384	95,101	340.05
Average	126,752.1	11,447.4	24,337.1	23,093.8	59,948.6	7,925.1	28.33
Percentage	100.00	9.03	19.20	18.22	47.30	6.25	

TABLE 5

Computed marketing spread and breakdown of marketing expenses for copra produced in Cavite in 1952 [a]

ITEM	AVERAGE AMOUNT	PERCENTAGE OF PREVAILING VALUE IN MANILA
	pesos	*pesos*
Value of 238 kilograms of copra, Manila Resecada price less 10% [b]	60.69	100.0
Price received by farmers for 1,000 nuts	46.87	77.2
Total marketing spread	13.82	22.8
Transporting 1,000 nuts from plantation to *tapahan*	2.77	4.6
Cost of making copra from 1,000 nuts	3.50	5.8
Transporting copra to Manila	3.57	5.9
Loading and unloading copra	0.83	1.3
Internal revenue fee for selling copra	0.47	.8
Miscellaneous costs and profit	2.68	4.4

[a] Based on an average of 238 kilograms of copra produced from 1,000 nuts, as reported by the producers.

[b] Based on the average Manila price of ₱28.33 for a hundred kilograms of copra Resecada basis, less 10% for all purchased as BC.

THE INFLUENCE OF SULFAMETHAZINE ON MORTALITY OF CHICKS RAISED ON BUILT-UP LITTER[1]

LUDOVICO N. TAYAG

WITH ONE TEXT FIGURE

Mortality in the control lot was more than twice that in the experimental lot. At weaning age, the birds in the lot treated with sulfamethazine weighed 839.2 ± 14.8 grams, and the control birds, 785.9 ± 18.6 grams. The control birds needed 5.09 kilograms of feed to produce a kilogram gain, whereas the experimental birds needed only 4.28 kilograms. Higher returns above feed and sulfamethazine costs were obtained in the treated lot.

Sulfamethazine seemed to be effective in the control of coccidiosis, but apparently had little curative effect on roup.

One of the most important causes of failure in the poultry business is the high death toll due to outbreaks of diseases. Hence, when a disease sets in, medication that will quickly control the outbreak becomes necessary.

Local poultry raisers believe that coccidiosis and roup are two causes of high mortality in chicks. In the market, nowadays, are a number of medicinal drugs for subduing coccidial and roup infections. One of the most popular of these medicines is sulfamethazine. Though relatively expensive, it has been widely used because it is claimed to be highly effective in the treatment and control of coccidiosis and, to a lesser extent, of roup.

Experiments conducted by Seeger,[2] Gordeuk, Learned, and Thorp,[3] Skjerven,[4] and Barber[5] showed that sulfamethazine was effective in controlling losses from coccidiosis under controlled and natural conditions. With the aim of verifying this report locally, this study was conducted from March to November, 1952, in the Department of Animal Husbandry.

MATERIALS AND METHODS

A total of 272 day-old New Hampshire chicks was used: 45 chicks in each lot in the first trial, 50 in each lot in the second trial, and 41 in each lot in the third trial. Each trial, consisting of two lots,

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[1] Central Experiment Station Contribution No. 1696. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture. Prepared in the Department of Animal Husbandry under the direction of Instructor Amado C. Campos.

[2] KARL SEEGER, *Poultry Sci.*, 25, 411 (1946).

[3] S. GORDEUK, JR., M. LEARNED, AND W. T. S. THORP, *Vet. Bull.*19, 201 (1947).

[4] O. SKJERVEN, *Vet. Bull.*, 19, 394 (1948).

[5] C. W. BARBER, *Poultry Sci.*, 271, 60 (1948).

lasted for 12 weeks. Lot I birds received no treatment, but lot II birds were given sulfamethazine. As recommended by the manufacturer,[6] the intermittent method was followed in the treatment of coccidiosis and the continuous method in roup medication. As soon as early signs of coccidiosis were noticed, the birds were given sulfamethazine for two successive days. Then, the second and third one-day treatments were administered at intervals of four days. For roup, a two-successive-day treatment was given. In the first trial, both liquid and powder forms of sulfamethazine were used, but in the last two trials only the powder form was used. The 12.5 per cent liquid sulfamethazine was added to the drinking water at the rate of two tablespoonfuls to a gallon of water, whereas the powder form was mixed with the mash at ¼ per cent of the total feed.

The chicks were raised in two similar pens provided with electrically heated brooding compartments, ground runs, and concrete floors with built-up rice hull which had been used as litter in some feeding experiments. The same litter was used in the first two trials. The chicks in the last trial were raised in other pens with built-up litters previously used by broods which were infected with roup and coccidiosis.

During the first four days of the experiment, the chicks were confined in the brooding compartments. On the fifth day, feeding and watering troughs were placed outside the pens to encourage the birds to go out. Later the ground runs were made available to the chicks. After the third week, the brooders were heated only at night and during the day when the weather was inclement. The heat was totally removed after the fifth week.

Since only the lot II birds were affected with roup in trial 1, birds in the second and third trials had their pens interchanged every week.

The chicks were fed with the College brooding mash consisting of the following ingredients, all parts by weight:

Fine rice bran	55
Fish meal	20
Ground yellow corn	20
Copra meal	5
Salt, 1 per cent of the ration	

In addition, chopped green feed was given twice a week after the first week. Drinking water and ground shells and grit were made accessible to the birds all the time. Both lots received identical care and management.

The initial weights and the weekly weights of the birds up to the twelfth week of age were recorded. Records on the rates and causes of mortality and the amounts and costs of feed and sulfamethazine consumed were also kept.

[6] Lederle Laboratories Division, American Cyanamid Company.

RESULTS AND DISCUSSION

Rate of growth. The growth of the chicks was measured by their weights at different ages (table 1). There was not much difference in the initial weights of the chicks of the two lots. In trial 1, the rates of growth in the two lots were practically the same. Although the lot II birds were a little heavier during the first six weeks, they were surpassed by the lot I birds during the last six weeks of the observation period. In this last half of the trial, roup infection broke out in lot II, causing a low feed intake which resulted in slow growth of the birds. At the end of the 12-week period, lot I weanlings were heavier than lot II weanlings on the average. In trial 2, the birds in the treated lot outgrew the birds in the control lot throughout the whole period. The results of trial 3 showed a striking difference in the rate of growth of the two lots. During the first three weeks, both lots weighed almost the same. At the start of the fourth week, the birds in the experimental lot showed accelerated growth, but the control birds failed to make good gains because of the prevalence of diseases. The average of the three trials indicated that the chicks in the treated lot excelled the control birds in growth (table 1a) throughout the 12-week period.

Feed consumption and cost. The experimental birds, being bigger on the average, consumed more feed than the control birds (table 3). The slight increase in feed intake of lot I birds in the first trial was more than offset by their very low consumption of mash in the last two trials. In the third trial, the feed intake of lot II birds was almost twice that of lot I birds.

In the amount of feed required to produce a kilogram gain, the difference between the two lots was appreciable; the experimental birds were more efficient in converting feed than the control birds.

Sulfamethazine consumption and cost. Only the chicks in lot II were given sulfamethazine. Chicks in trial 2 consumed the greatest amount of the medicine because there were more of them. Besides, the birds were infected with roup earlier so that more treatments were administered. It was observed that sulfamethazine had apparently little effect on roup.

Returns above feed and sulfamethazine costs. Lot I gave higher returns above feed and sulfamethazine costs than lot II in the first trial, but gave lower returns in the last two trials (table 3).

Mortality rates and causes. In the first trial, lot II birds had a higher mortality although they were treated with sulfamethazine (table 2). This may be due to the fact that in this trial, only lot II birds were attacked by roup-causing organisms. Furthermore, two of the lot II birds died before any treatment was given. In the second trial, 88 per cent of the birds were weaned in lot II as compared to only 70 per cent in lot I; the mortality in lot I was more than twice that in lot II. In trial 3, more than one-half of the birds in lot I died during the 12-week period, whereas almost all of the lot II

birds reached weaning age. On the whole, mortality of the lot I birds was more than double that of lot II birds.

The rates of mortality of the lot I birds differed greatly in the three trials, probably because of the variations in weather. Outberaks of diseases seem to occur more frequently during the rainy season when the weather is humid and warm. Thus trials 2 and 3, which were conducted during this season of the year, had higher mortality than trial 1.

In table 2a, the data show that coccidiosis and roup were the most prevalent diseases [7] in both lots in all the trials, with coccidiosis causing the greater mortality in lot I. Next to coccidiosis in severity was roup. Coccidiosis, occurring earlier than roup, was more prevalent in the first half of the trial, whereas roup was more prevalent in the last half. Other causes of mortality were also observed. Roundworm infestation was common in both lots as shown by the birds' droppings in all the trials. However, only one chick was confirmed to have died of roundworms. Low vitality and crowding of the birds were other causes of death. Some of the birds examined showed signs of leukosis. Two had abscess infections. A few of the dead birds could not be diagnosed for the exact cause of death as they did not show any signs of disease.

Effectiveness of sulfamethazine. The results of this study seem to indicate the effectiveness of sulfamethazine in the control of coccidiosis. In the treatment of roup, however, the drug appeared to have little curative effect.

Other observations. In all the trials, the experimental birds appeared healthier and more uniform in growth than the control birds, except in the last part of the first trial when the two lots were more or less comparable. Lot 11 birds started to farther earlier, but at the end of the trials, the birds in both lots were well covered with feathers. It was also observed in all the trials that the chicks in the two lots were infested with red mites.

[7] Diagnosis was by Dr. F. Mensalvas, the College veterinarian.

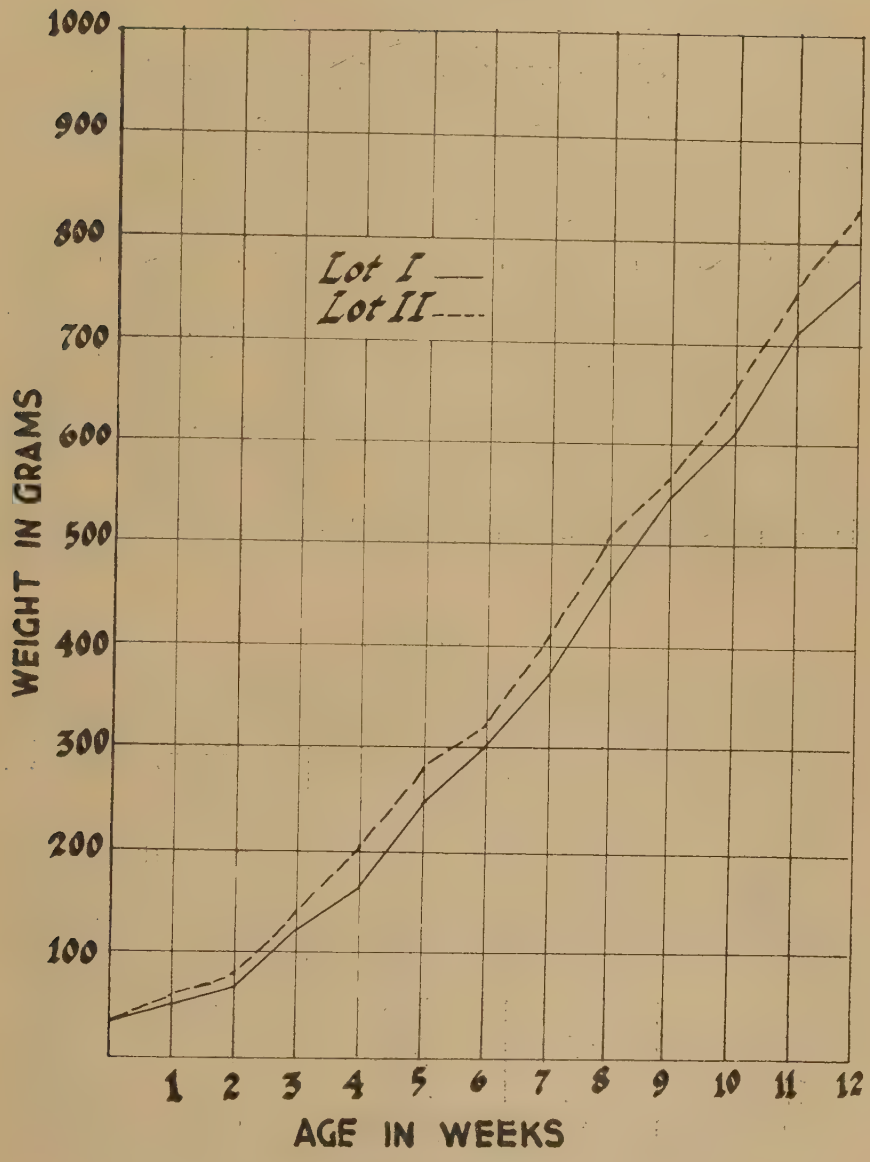

Fig. 1.—Rate of growth of the chicks in the trials.

TABLE 1

Mean initial and weekly weights in grams of the New Hampshire chicks in the three trials

AGE IN WEEKS	LOT I			LOT II		
	Trial			Trial		
	1	2	3	1	2	3
Initial	40.5	34.4	36.9	38.0	36.0	37.1
1 week	43.8	54.3	49.8	47.1	56.5	51.7
2 weeks	71.5	87.5	81.4	81.3	91.6	82.9
3 "	131.2	134.0	124.1	144.7	159.9	123.7
4 "	172.0	170.9	154.4	195.0	218.2	185.7
5 "	278.4	254.3	195.3	303.5	313.4	242.5
6 "	340.3	291.7	264.3	348.4	337.2	309.1
7 "	436.3	379.5	293.2	435.8	428.5	379.1
8 "	541.7	454.1	395.7	537.0	497.5	481.0
9 "	639.0	544.8	425.9	630.6	593.1	525.5
10 "	688.5	608.8	506.3	680.8	645.2	677.1
11 "	805.0	698.2	578.3	785.2	743.3	774.8
12 "	874.9±24.9	759.2±27.2	652.3±37.2	853.7±26.6	780.4±18.4	894.5±29.6

TABLE 1a

Total number of New Hampshire chicks and their mean initial and weekly weights in the three trials

AGE IN WEEKS	LOT I		LOT II	
	Total no. of chicks	Mean weight	Total no. of chicks	Mean weight
		grams		*grams*
Initial	136	37.2	136	37.0
1 week	132	49.6	132	52.0
2 weeks	126	80.6	131	84.5
3 "	123	129.1	128	144.4
4 "	123	166.0	127	201.1
5 "	115	245.3	127	289.1
6 "	111	300.6	127	332.3
7 "	108	375.2	125	415.8
8 "	104	471.8	123	504.5
9 "	99	554.3	122	584.0
10 "	96	618.7	121	666.7
11 "	94	717.0	120	766.5
12 "	93	785.9 ± 18.6	118	839.2 ± 14.8

TABLE 2

Mortality rates in the two lots

ITEM	LOT I				LOT II			
	Trial			Total	Trial			Total
	1	2	3		1	2	3	
Number of chicks at start of experiment	45	50	41	136	45	50	41	136
Number of chicks after 12 weeks.	39	35	19	93	37	44	37	118
Number of chicks that died	6	15	22	43	8	6	4	18
Percentage of mortality	13.3	30.0	53.7	31.6	17.8	12.0	9.8	13.2

TABLE 2a

Causes of mortality

CAUSE	LOT I				LOT II			
	Trial			Total	Trial			Total
	1	2	3		1	2	3	
Coccidiosis	5	5	8	18	3[a]	0	1	4
Roup	0	7	7	14	4	4	0	8
Coccidiosis & roup	0	1	0	1	0	0	0	0
Other causes	1	2	7	10	1	2	3	6
Total	6	15	22	43	8	6	4	18

[a] Two died before any sulfamethazine was given.

TABLE 3

Costs of feed and sulfamethazine consumed and returns above costs

ITEM	LOT I				LOT II			
	Trial			Average [a]	Trial			Average [a]
	1	2	3		1	2	3	
Amount of feed consumed, kg.	137.4	118.4	68.0	107.93	130.0	149.8	123.3	134.37
Cost of feed consumed, pesos [b]	39.71	34.22	19.65	31.19	37.57	43.29	35.63	38.83
Total gain in weight of the birds, kg.	32.30	24.85	10.88	22.68	29.88	32.54	31.58	31.33
Amount of feed required to produce a kilogram gain, kg.	4.25	4.76	6.25	5.09	4.35	4.60	3.90	4.28
Cost of feed required to produce a kilogram gain, pesos	1.23	1.38	1.81	1.47	1.26	1.33	1.13	1.24
Amount of sulfamethazine consumed	—	—	—	—	405 cc. 4.4 grams	70 grams	40 grams	
Cost of sulfamethazine used, pesos [c]	—	—	—	—	4.57	5.08	2.90	4.18
Weight of weanlings produced, kg.	34.12	26.57	12.39	24.36	31.58	34.34	33.10	33.01
Returns from sales of weanlings, pesos [d]	85.30	66.43	30.98	60.90	78.95	85.85	82.75	82.52
Actual returns above feed and sulfamethazine costs, pesos	45.59	32.21	11.33	29.71	36.81	37.48	44.22	39.50

[a] Average of the three trials.
[b] ₱0.289 a kilogram.
[c] Sulfamethazine powder, ₱33 a pound; sulfamethazine liquid, ₱40 a gallon.
[d] ₱2.50 a kilogram live weight.

A TRIAL PREPARATION OF BILBAO STYLE SAUSAGE [1]

FAUSTINO MENSALVAS AND FARO B. BENITEZ

Five experimental formulae and two methods of preparing Bilbao style sausage were tried. On the basis of texture, color, aroma, and taste, only the smoked samples of formula II and the control were rated good. The refrigerated samples of these formulae were only rated fair, and the smoked as well as the refrigerated sausages of the other formulae were rated either fair or poor. The higher quality of the sausages of formula II and the control may be attributed to the kinds and amounts of ingredients used combined with the smoked method of preparation.

Bilbao style sausage, a meat product in great demand locally because of its commendable flavor, is being imported in large quanties. To manufacture this product and to reduce, if not altogether curtail, its importation have long been objectives of sausage manufacturers in this country. They have not succeeded, however, inasmuch as a number of secrets about the manufacture of the imported product have not yet been uncovered. In an endeavor to help improve local formulae and methods of manufacture, this study was done in the Department of Animal Husbandry and in Mondy's Ham and Sausage Factory [2] at Anos, Los Baños, Laguna, from December, 1951, to December, 1952.

MATERIALS AND METHODS

Pork. Sixty kilograms of fresh lean pork from the Department of Animal Husbandry were ground in a meat grinder with a ¼-inch plate.

Casing. As casing, 6.6 kilograms of small intestines of hogs and of cattle, when those of swine were not available, were used. The intestines were prepared according to the method followed by Sumulong and Fernandez (1937). For convenience, the intestines were cut to lengths of one meter.

Lard. Twenty-five kilograms of lard were used to arrest the shrinkage of the sausages and to preserve them until the end of the experiment.

Seasoning ingredients. One kilo and 940 grams of "El Carabao" Spanish pimenton, 1.940 kilograms of refined sugar, 1.695 kilograms of refined and coarse salt, 0.215 kilogram of saltpeter, 0.066 kilogram of ground garlic, 0.115 kilogram of ground black pepper, 0.015 kilogram of "McCormic Rubbed Sage," and 0.200 kilogram of "Rose Bowl" vinegar of 4 per cent acidity were used as seasoning.

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[1] Central Experiment Station Contribution No. 1697. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture. Prepared in the Department of Animal Husbandry under the direction of the senior author.

[2] The writers are indebted to the owner, Dr. M. Mondoñedo, for technical help and facilities extended during this study.

Formulae. The following five experimental formulae, based on the weight of pork, were tried in the two methods of preparing Bilbao style sausage:

INGREDIENTS	I	II	III	IV	V
	per cent	*per cent*	*per cent*	*per cent*	*per cent*
Pimenton	2.5	2.7	3.0	3.5	4.0
Sugar, refined	2.5	2.7	3.0	3.5	4.0
Salt, coarse	2.0	2.5	2.7	3.0	3.5
Saltpeter	0.5	0.4	0.35	0.3	0.2
Garlic, ground	0.2	0.15	0.08	0.1	0.05
Pepper, ground	0.4	0.3	0.25	0.2	—
Vinegar	—	2.0	—	—	—
Sage	—	—	0.15	—	—

The control was the following formula used by Sumulong and Fernandez (1937):

INGREDIENTS	*per cent*
Pimenton, ground	3.7
Sugar, refined	3.7
Salt, refined	3.25
Potassium nitrate or saltpeter	0.4
Garlic, ground	0.08

No attempt was made in this study to blend different kinds of meat, as is done in the manufacture of imported "chorizos" (Encyclopaedia Britannica, 1947), so that the resulting product would be comparable with domestic sausages, especially those prepared by the method of Sumulong and Fernandez.

Refrigerated method. The seasoning ingredients according to the percentages indicated in the formulae were mixed thoroughly by hand. Five kilograms of ground pork were placed in an aluminum pail, and the ingredients were put in as the meat was mashed by hand. The seasoned pork was placed in a sausage stuffer and was forced out by pressure through a nozzle into the casing. The casing was not fully packed to allow margin for linking.

The sausages were then linked by applying pressure on the casing with a finger at 4-to 6-inch intervals depending upon the size of the casing used. The unlinked portions were twisted and tied with coarse-ply thread. After linking, the sausages were weighed and hung inside a walk-in refrigerator for 40 days. The refrigerator had a temperature range of 36° to 38°F. (2.2° to 2.8°C.).

During the period of refrigeration or curing, a species of yeast, *Debaromyces guilliermondii*,[3] was found growing on the surface of the sausages. The sausages were washed with tap water, then wiped with a dry, clean cloth to remove the yeast. They were put back in

[3] Identified by Mr. W. Fernandez, of the Department of Plant Pathology.

the refrigerator and kept there until the 40 days were up. They were cleaned four times during the whole course of refrigeration.

Immediately after refrigeration, the products were air-dried in a room of ordinary temperature (80.0°F. or 26.7°C.) until they had shrunk to an average of 45 per cent of their initial weight. The purpose of air-drying was to further cure, drain, and harden the sausages under room temperature. During the process, the same species of yeast grew on the surface of the sausages. This time the yeast was scraped off with a knife and the sausages were wiped with a dry, clean cloth.

To arrest shrinkage and, at the same time, to preserve the sausages until the end of the experiment, the sausages were immersed in hot lard for two minutes and then placed in jars. After the lard had cooled, it was poured into the jars until the sausages were completely submerged. Then the jars were covered tightly with screw lids.

Immersion of the sausages in lard is not always a part of the process of manufacturing this style of sausage. This step only becomes a necessity when the products are not used immediately after the desired shrinkage has been attained.

Smoked method. The smoked method differs from the refrigerated method only in the initial curing process. After the sausages had been linked, they were immediately placed inside the smokehouse and allowed to stay there for two days. Then they were also air-dried at room temperature. The smokehouse temperature ranged from 105° to 115°F. (40.0° to 46.1°C.).

Testing of the products. Six housewives on the College campus were requested to sample the sausages made from the experimental formulae and the control and to comment on their texture, color, aroma, and taste. Since all the testers could not be present for five consecutive days, the products were judged on January 29 and 30 and February 3, 5, and 6, 1953. Sampling started at 2:30 in the afternoon.

Before the testing, the judges were told of the desirable qualities of the Bilbao type of sausage. They were requested to follow certain rules so that the data would be as accurate as possible. These rules [4] were as follows:

1. Do not take highly flavored food two hours before sampling.
2. Do not taste the sample rapidly. Roll it slowly in the mouth.
3. Do not swallow the sample.
4. Rinse the mouth with lukewarm water after testing each sample.
5. Concentrate on testing and, as much as possible, be independent in your judgment.

[4] Thanks are due to Mrs. B. Oñate for suggestions on how to conduct this test.

Comments on texture, color, aroma, and taste were expressed in such terms as "Excellent," "Very good," "Good," "Fair" and "Poor." These were supplemented with more specific descriptions like salty, sweet, peppery, etc. The comments were given numerical equivalents, as follows:

Excellent	10 points
Very good	9 "
Good	8 "
Fair	7 "
Poor	Below 7 "

Each sample was fried for 10 minutes after the lard had started boiling. For samples from large sausages, the time of cooking was extended for five minutes. After every sample was cooked, the lard was changed to avoid confusion in the determination of flavor. The sausages were sliced and the samples were designated by code instead of according to formula or method of preparation. A different code was used every testing day to minimize biased findings as much as possible. Also, the ingredients and their respective amounts were not made known to the judges.

The testing of the products was done at least two hours after lunch to prevent whatever food the testers had taken from influencing their findings. The acceptability of their findings was determined by their general average of deviation for the five days of testing. Average deviation was determined by dividing the total deviation (not considering the sign of the numbers) by the number of samples. The average deviation had to be less than 2.00 units in order that the tester's findings could be used in the determination of the final rating of the 12 samples.

The method employed to determine the reliability of all the findings of the testers was patterned after that of Crocker (1945). Certain modifications were made to suit the present work since Crocker's example was the appraisal of dairy products. Also, fewer samples were tested, and there were 10 testing days. The maximum average deviation in Crocker's example was 1.00 unit, but in this study it was 2.00 units. All the testers in the example were tested as to their capacity for flavor perception. The lower average deviation used by Crocker was therefore justified.

The testers were given forms to fill out. Their comments on the different samples for the five-day test were then evaluated.

RESULTS AND DISCUSSION

Since all the average deviations of the six judges were below the 2.00-unit limit, all their findings were used in determining the final average scores for texture, color, aroma, and taste of the 12 samples. The sausages made from the different formulae were classified according to the number of points attained by the four bases of each

sample. The total number of points divided by four determined the classification of each sample.

Texture. The samples from the control and experimental formulae I and II were rated fair, which was the highest classification given for texture. The smoked sausages of experimental formulae III and V were also rated fair, but the refrigerated samples of the same formulae, together with the sausages from experimental formula IV, were rated poor. The variability of scores on texture was possibly due to psychological reasons. Hughes (1951) stated that awareness of texture qualities results from pressure on the receptors of the tongue. During the testing period, the pressure may have varied considerably with the same sample tested on different days.

Color. In color, only the smoked sausage of the control was rated good; its refrigerated sample was rated fair, together with the sausages of experimental formula II and the smoked sausage of experimental formula I. All the sausages of experimental formulae III, IV, and V were considered poor. Sausages with .5 to .4 per cent saltpeter apparently had better color than those containing less. The amount of pimenton in a sausage may have affected the color of the product, but the preservation of the color depended upon the amount of saltpeter. Ziegler (1944) believed that saltpeter produces the pink or red color in cured meat. The growth of yeast may have been a contributing factor to the slight differences in color intensity within a method.

Aroma. It was only in aroma that an experimental formula outranked the control. The smoked sausage of experimental formula II attained the classification very good, whereas the sausages of the control were only rated good. The sausages of experimental formula I and the refrigerated sample of formula II were rated fair. The rest were considered poor. The smoked sausages were generally favored by the testers because smoking gives the product an attractive aroma, improves the keeping quality to a certain extent, and gives a brick-red color to the surface of the sausage. This color, however, becomes dull within two weeks.

Taste. Of all the samples tested for taste, only the smoked sausage of experimental formula II received the rating very good, and only the smoked sausage of the control was rated good. The refrigerated sausages of the control and of experimental formula II were classified fair, together with the sausages of formula I. Experimental formulae III, IV, and V produced sausages of poor taste. Vinegar was used in formula II alone, which probably accounts for the superiority of its products since vinegar has a preservative effect and gives a characteristic taste that is desirable. The refrigerated sausages of formula II and the control did not rate as high as their smoked counterparts. This is probably because refrigeration most likely caused crystallization of some of the ingredients, decreasing their solubility. Consequently, the rate of mixing of these ingre-

dients was slower than in smoking. Furthermore, being a semipermeable membrane, the casing could have been penetrated by moisture, thus decreasing the strength of the ingredients.

Sage was used only in experimental formula III. Its presence may have been responsible for the inferiority of the sausages produced from this formula. Butler (1950) found that sage hastens rancidity of ground pork faster than salt or pepper at 0°F.

On the basis of the collective average scores on texture, color, aroma, and taste for the five-day test, the 12 samples were classified as follows:

Experimental formula II, smoked	Good
Control, smoked	"
Control, refrigerated	Fair
Experimental formula II, refrigerated	"
" " I, smoked	"
" " I, refrigerated	"
" " IV, smoked	Poor
" " IV, refrigerated	"
" " V, refrigerated	"
" " V, smoked	"
" " III, smoked	"
" " III, refrigerated	"

Sausages from both formulae IV and V were claimed to be sweet, the latter being more so. Samples from experimental formula III were found to be 'biting" or itchy on the throat in spite of the fact that the samples were not swallowed.

In the above classification, only the sausages of experimental formula II equalled those of the control. Samples from this experimental formula were submitted for proximate analysis, and the results were as follows: [5]

	SMOKED	REFRIGERATED
	per cent	*per cent*
Moisture	16.61	15.34
Crude proteins (N × 6.25)	23.60	22.47
Crude fats (ether extract)	48.32	50.08
Carbohydrates (N.F.E.)	6.04	4.06
Calorific value for every 100 grams	553.00	557.00
Crude fibers	1.43	1.82
Ash	4.00	6.23

For further information regarding the merits and demerits of the sausages of experimental formula II, an attempt was made to compare the experimental product with imported "chorizos" from Spain. Unfortunately, none could be found in the market so that "Chorizo Royal," the very salable product manufactured by Genato and Company in Manila, was used. Judging from the remarks of

[5] Determined by Mrs. M. Ylagan, of the Department of Agricultural Chemistry.

those who made the comparison, selected for familiarity with this kind of sausage, the sausages from experimental formula II not only compare well with Genato's "Chorizo Royal" but are in the same class as "Chorizos de Bilbao", although perhaps not as sprightly flavored.

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COLLEGE AND ALUMNI NOTES

Dr. Silverio M. Cendaña and Dr. Faustino T. Orillo were among the guest speakers at the Citrus Growers' Field Day held in Lipa City on January 3, 1953. Doctor Cendaña discussed insect pests of citrus and Doctor Orillo talked on diseases. Dr. Valeriano C. Calma was a member of the panel of experts which answered questions during the round-table discussion.

Director Domingo B. Paguirigan, '16, of the Bureau of Agricultural Extension, delivered an address. Mr. Jose de Leon, '16, spoke on cultural practices and orchard management. Mr. Ambrosio M. Lontoc, '20, district agriculturist of the Bureau of Agricultural Extension, was the general chairman. Other alumni who took active part were Dr. Juan P. Torres, '19, Dr. Dionisio I. Aquino, '21, Mr. Alfonso D. Tecson, '34, and Mr. Jose T. Tapay, '45.

The following were recently added to the College staff: Mrs. Luz Uichanco-Oñate, '48, and Miss Iderlina Cervantes, instructors in agricultural chemistry; Mr. Reynaldo Rodriguez, '53, and Mr. Victor Rimando, '53, instructors in agronomy; Mr. Quirino Villaviza, '53, instructor in animal husbandry; and Miss Gloria Vega, '53, instructor in agricultural economics.

The UP ROTC, Los Baños Unit, held a parade and review and presentation of sponsors in honor of the commander and staff of the II Military Area on December 17, 1952. Cadet Colonel Jose A. Cruz is the commander of the local Vanguard Fraternity. Captain Emiliano T. Mascardo is the adviser.

A Christmas program was held on December 19, 1952, at the Chemistry Lecture Hall under the auspices of the Student Body Organization of the College. A pageant was presented by the sophomores. Choruses were rendered by the seniors and the members of the Christian Youth Federation. Other numbers in the program were an instrumental solo by Ramon I. Ibarbia, '55, and vocal solos by representatives of the freshmen and the special students.

The Student Body Organization of the UP Rural High School sponsored a Christmas program on December 18, 1952, at the Chemistry Lecture Hall. Two plays, "The Christmas Angel" and "Alabok ng Daan," were presented. Other features of the affair were an interclass Christmas carol singing contest, a lantern contest, and a chorus by the RHS Glee Club. Prizes were given to the winners of the contests and to the best actor and best actress in each play. The freshman class under Miss Elsa B. Lapuz won first place in the carol singing contest. Jose Sandejas, Jr., and Aniceto Malabanan were chosen best actors; Elvira Paelmo and Nelia Evangelista, best actresses.

A Christmas program was presented by the Maquiling School on the afternoon of December 19, 1952. The program included a

chorus by Maquiling School pupils, recitations by Elena Bautista, Irma Umali, and Arturo Maligaya, folk dances, a motion song, a playlet, and an operetta, "Surprise Christmas." The program was climaxed by the distribution of Christmas gifts donated by the Maquiling Ladies' Club and the Beta Sigma Fraternity.

Mr. Quintin L. de la Torre, '50, is junior fertilizer supervisor in Misamis Occidental.

Mr. Cayetano G. Galve, '49, is managing his own farm in Sigma, Capiz.

Mr. Marcelo G. Macaraeg, '47, is junior fertilizer supervisor in Pangasinan.

Mr. Leodegario J. del Rosario, '48, is teaching agriculture at the Oriental Mindoro High School in Calapan.

The College is appealing to its alumni for donation of the following issues of *The Philippine Agriculturist* to complete its collection in the College Library.

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